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THE BROADBAND ASSOCIATION

What's Next in Ultra Broadband

ADTRAN®

Richard Goodson

Director, Industry Standards and Technology Analysis

March 30th, 2012

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Richard Goodson
Director, Industry Standards and Technology Analysis
CTO Office
ADTRAN

Outline

- Market Drivers
- What's Next in Wired Access?
  - Bonding
  - Vectoring
  - FTTDP
  - FTTH
  - Edge Packet Optical
- What's Next in Wireless Access?
  - Wi-Fi
- Summary
- Q&A

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Reinventing Access

ULTRA BROADBAND FTTH OPTICAL NETWORKING EDGE MOBILE BACKHAUL ETHERNET SERVICE MIGRATION SERVICE MANAGEMENT

Market Drivers

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2020 Goal: Ubiquitous 100Mbps Broadband

Impact on Well Being

“Savings in the health sector …to fall between 1.4% and 3.7% as a direct result of having the new network in place.”

ITU National Broadband Plan Recommendations

“… 10% increase in broadband penetration …1.3 % additional growth in GDP.”

ITU National Broadband Plan Recommendations

Global Market Success Drivers

Higher bandwidth results in more exciting applications leading to increased adoption and higher revenue per user.

Launched in the last six years

facebook iTunes hulu YouTube flickr LinkedIn

Super-connected subscribers will lead to new industries and corporations we can't even imagine yet.

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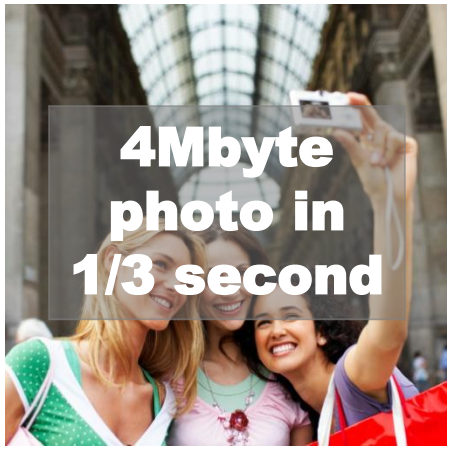
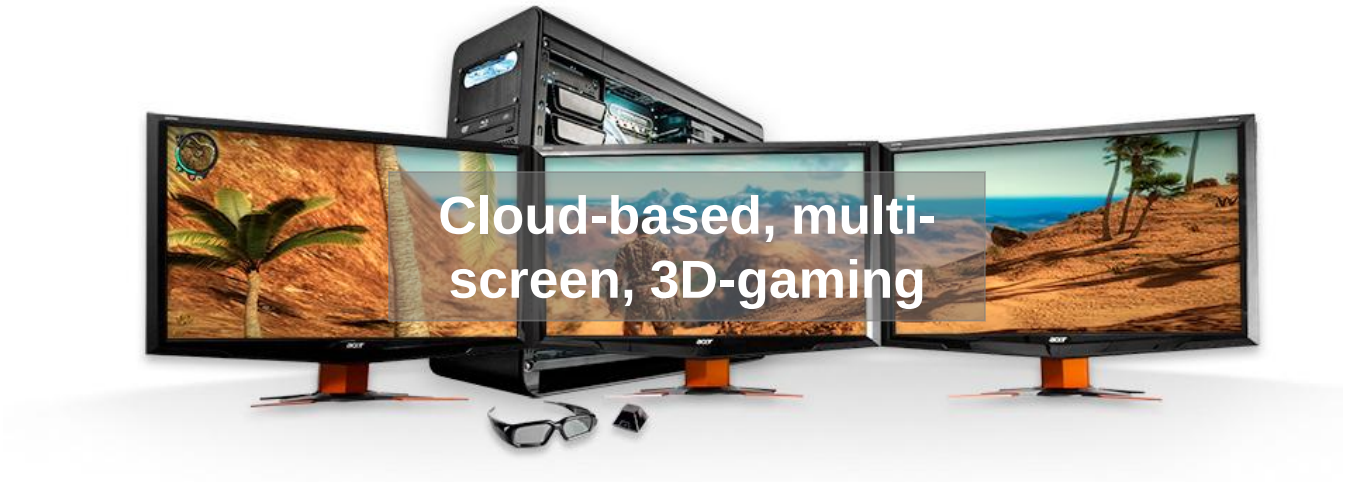
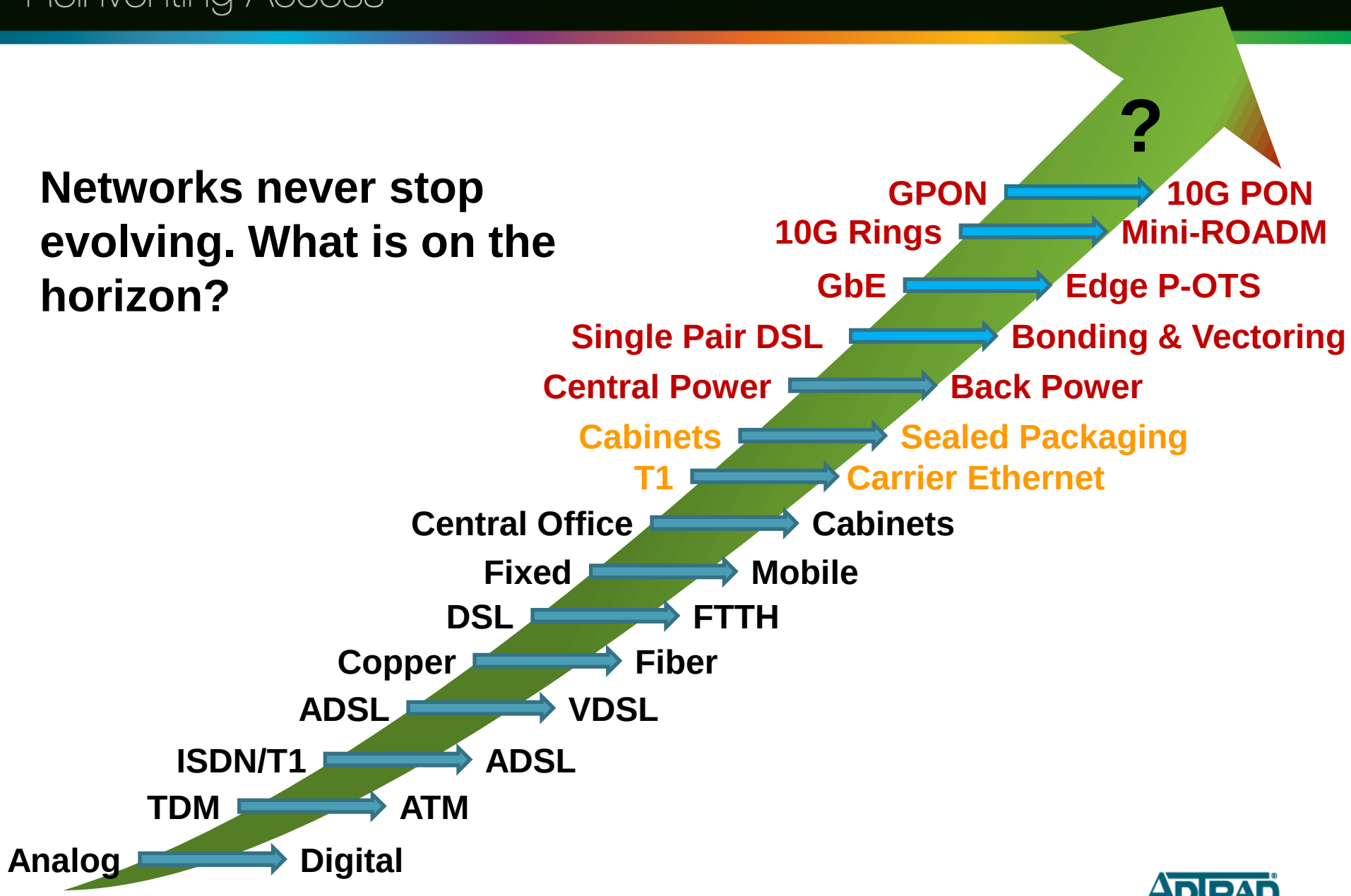
100Mbps+ Downstream: 25x Faster Than Today's Average



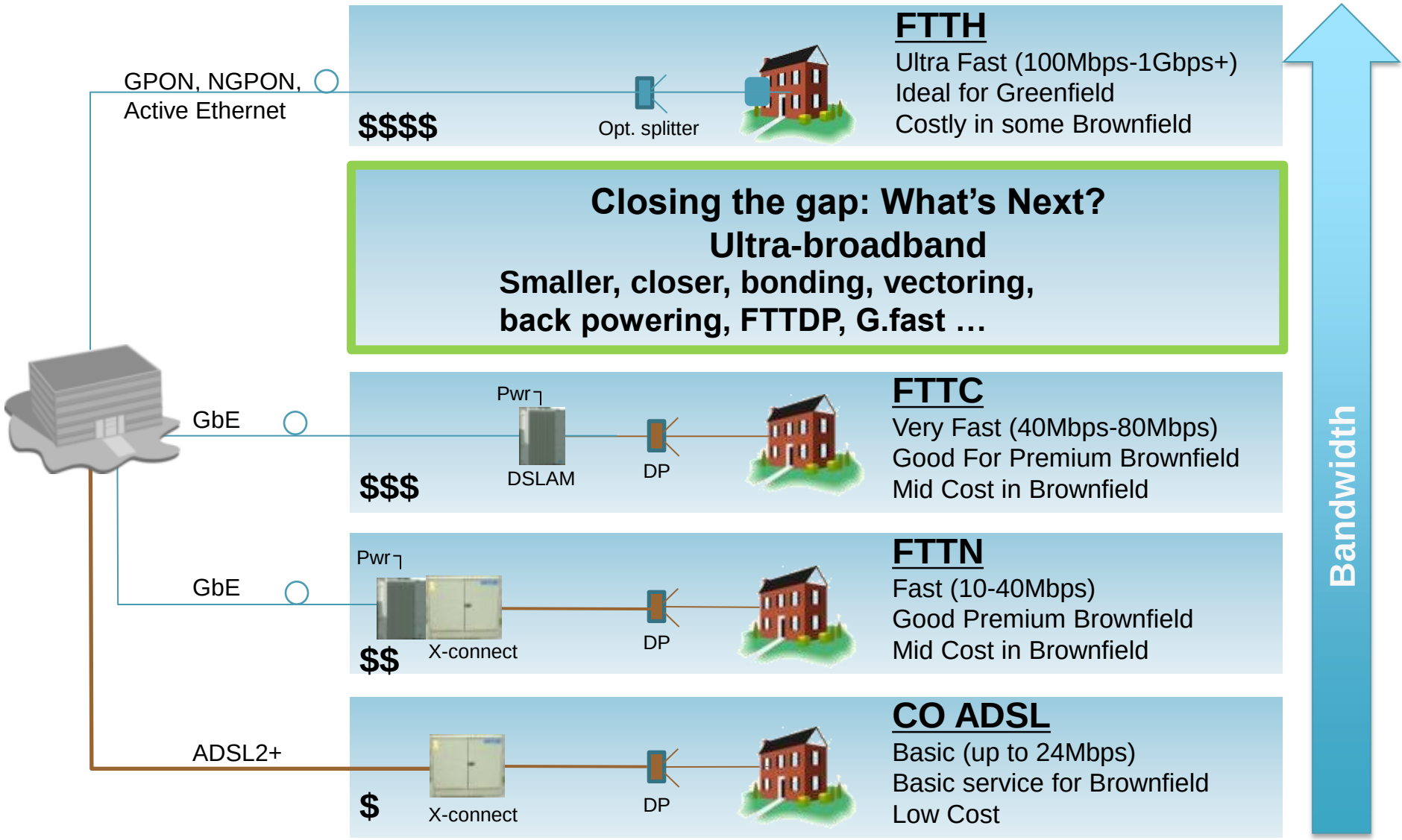


Networks never stop evolving. What is on the horizon?



What's Next In Wired Access?

Closing the Gap



Closer to the Customer, Smaller Packaging

Exchange

Cabinet

Node

Distribution Point

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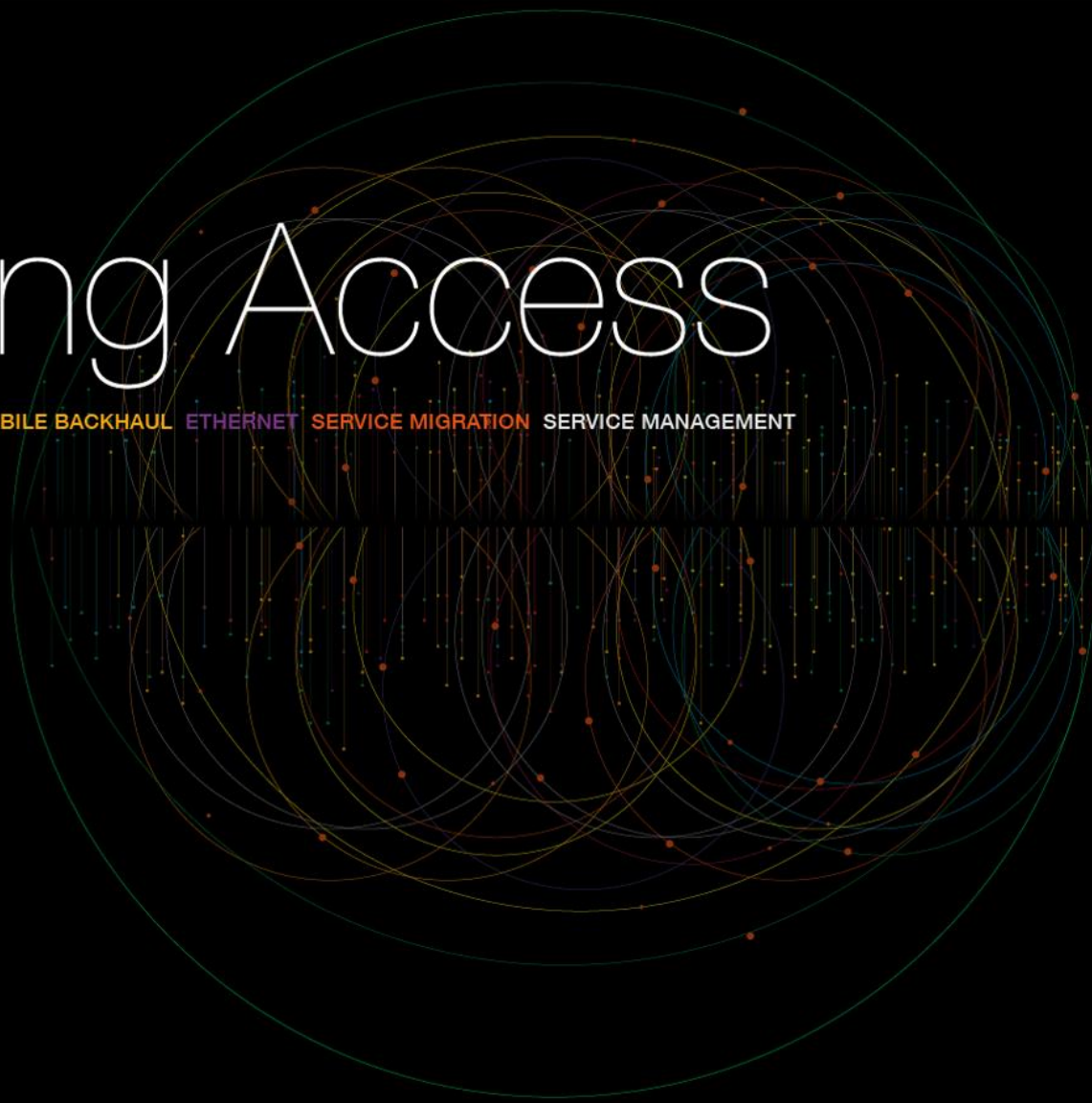
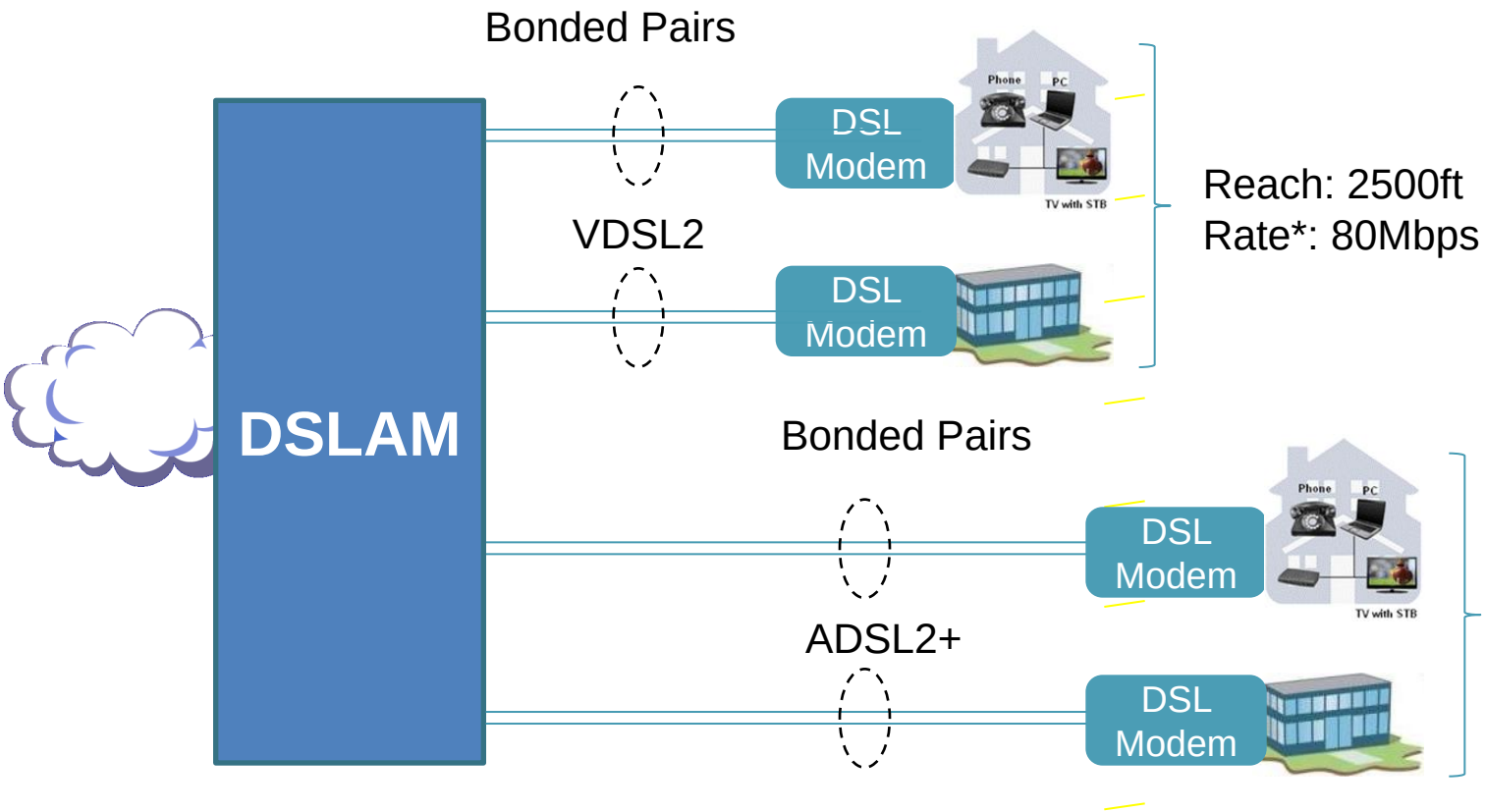


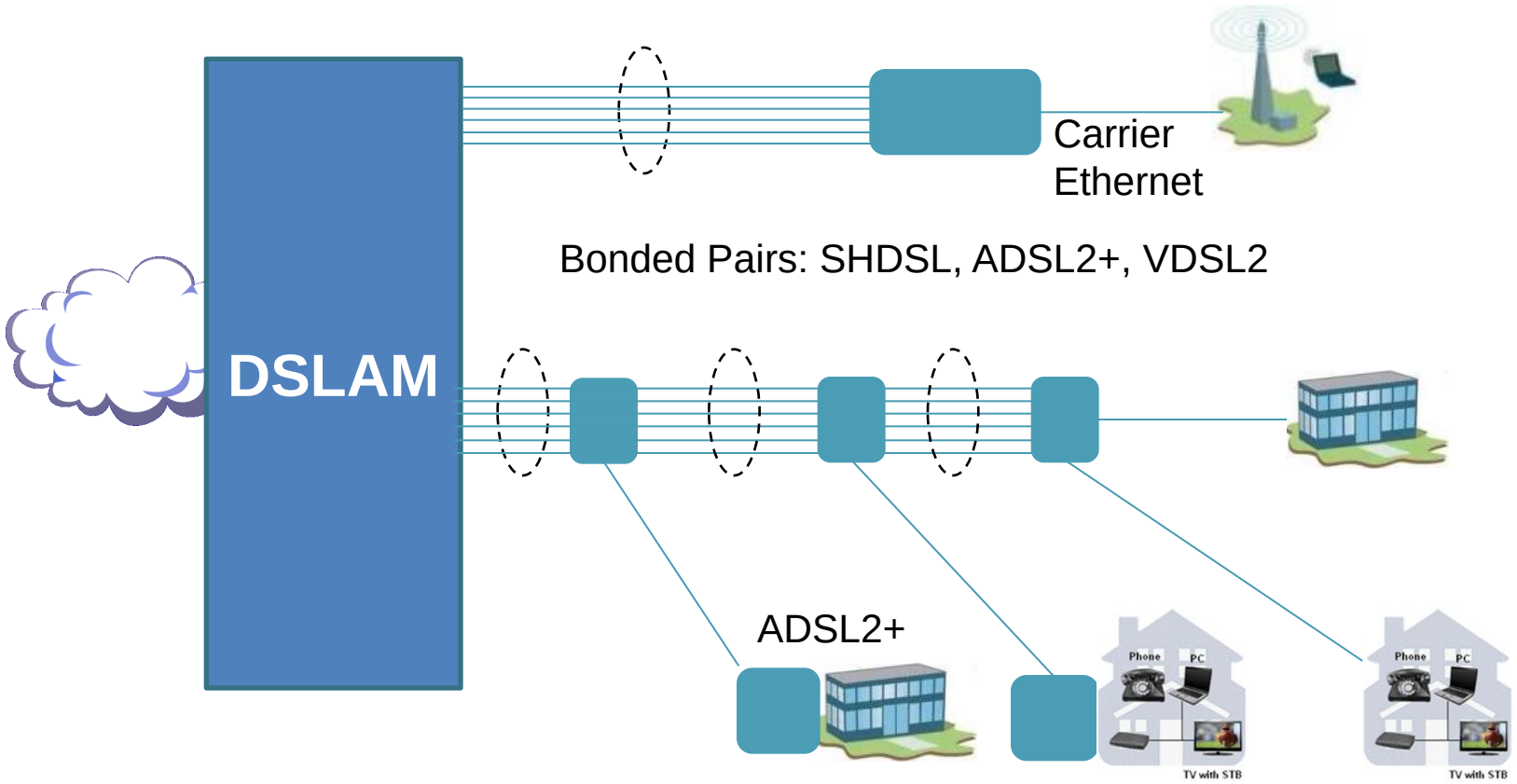
Bonding

Bonding. . .The Basics



*2-pair bonded, no vectoring

Multi-pair Bonding



Multi-pair bonding can be used to deliver hundreds of Mbps into the network and reach the unreachable with premium services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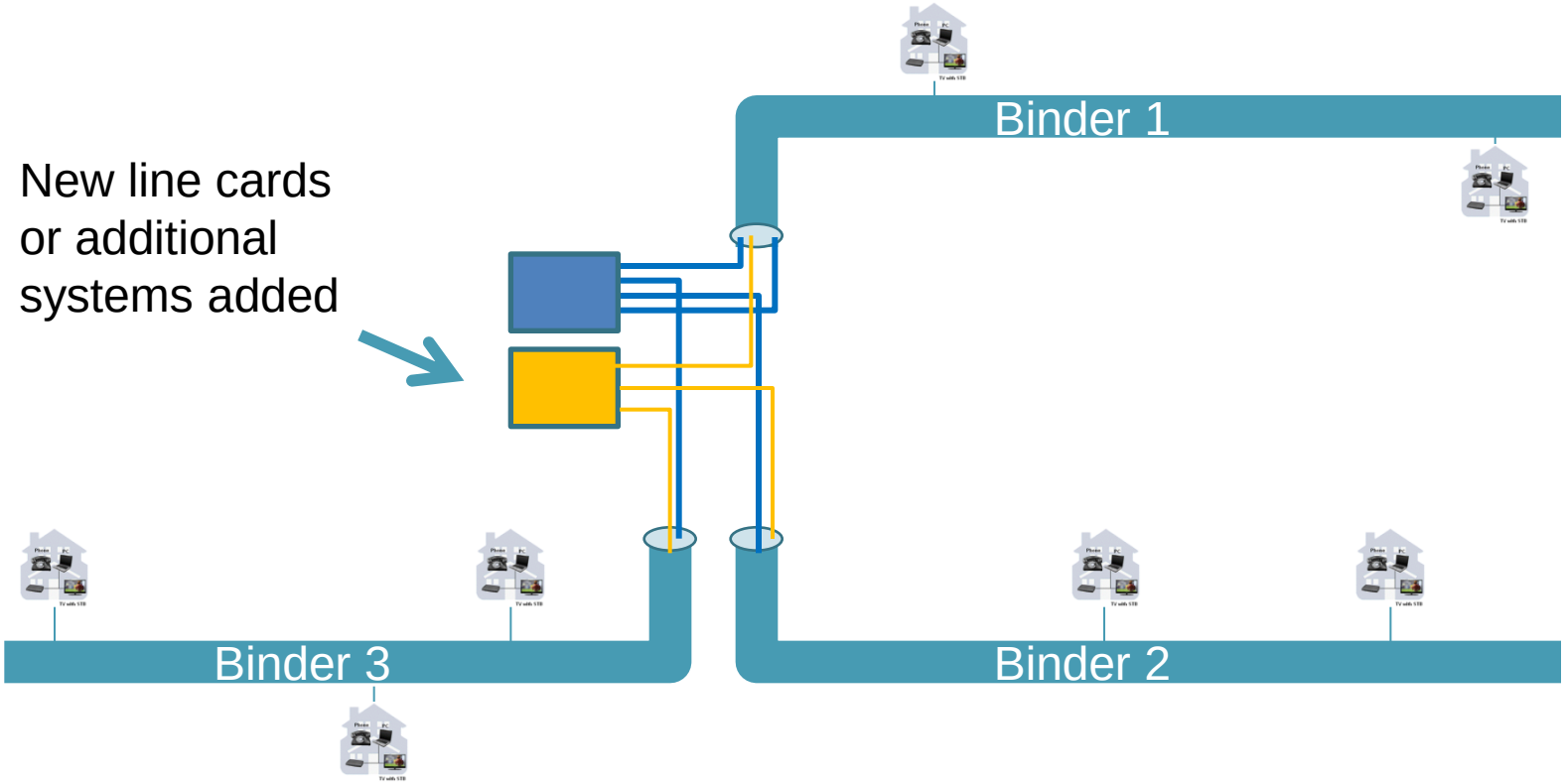
Vectoring

Binders. . . The Basics

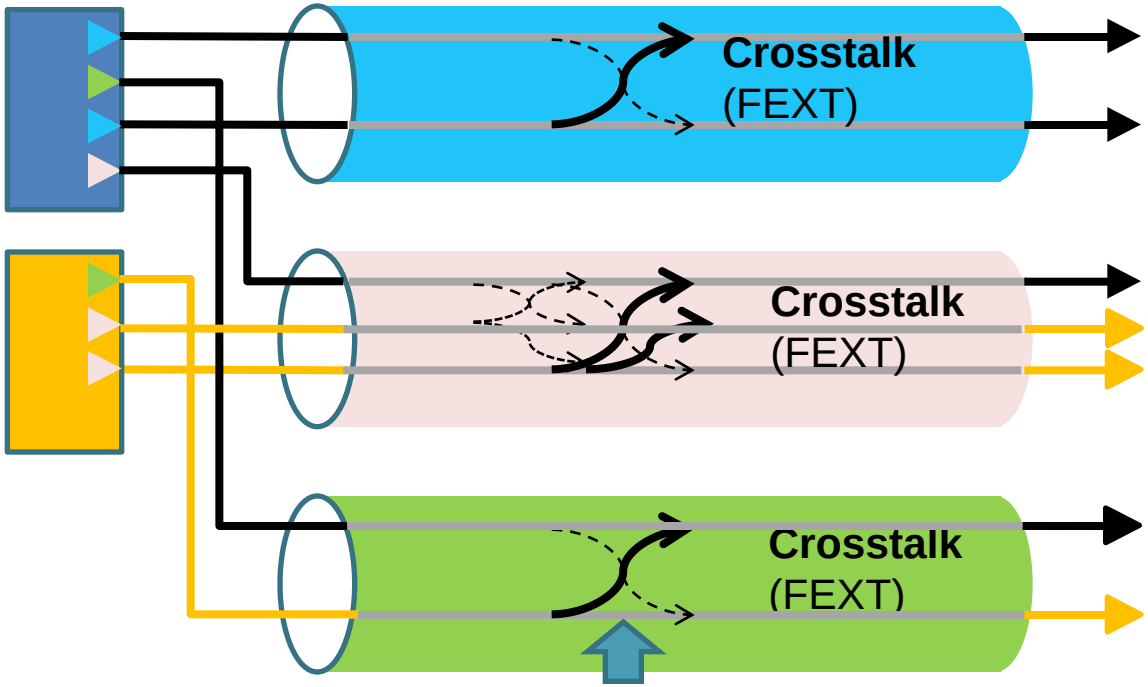
New line cards or additional systems added



There is no one-to-one correlation between DSLAMs and binders.

Crosstalk - The Problem

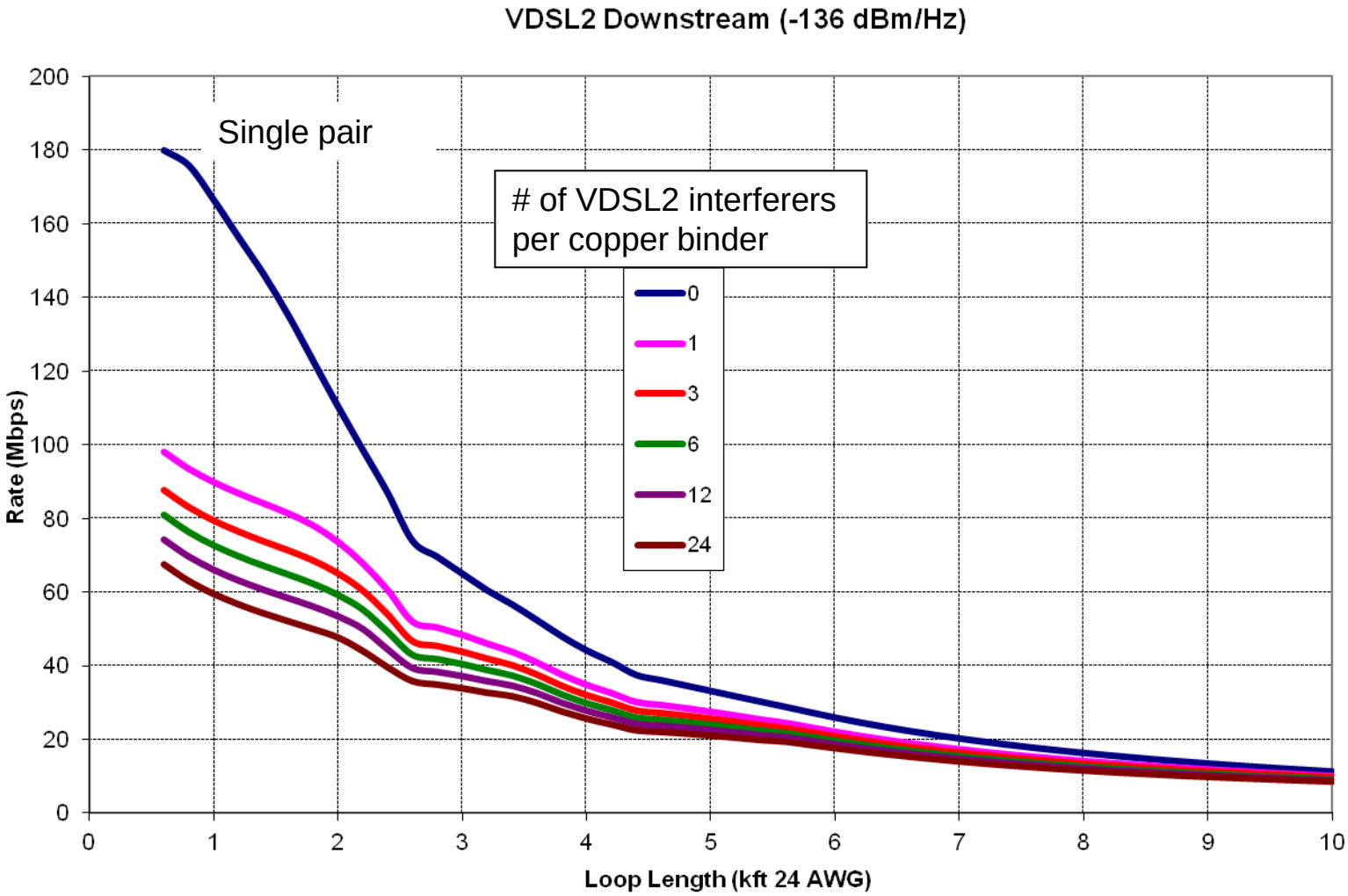
Significant Performance Impact



Crosstalk from one pair to another in a binder group distorts signals and lowers bandwidth on each pair.

Noise and VDSL2 Performance

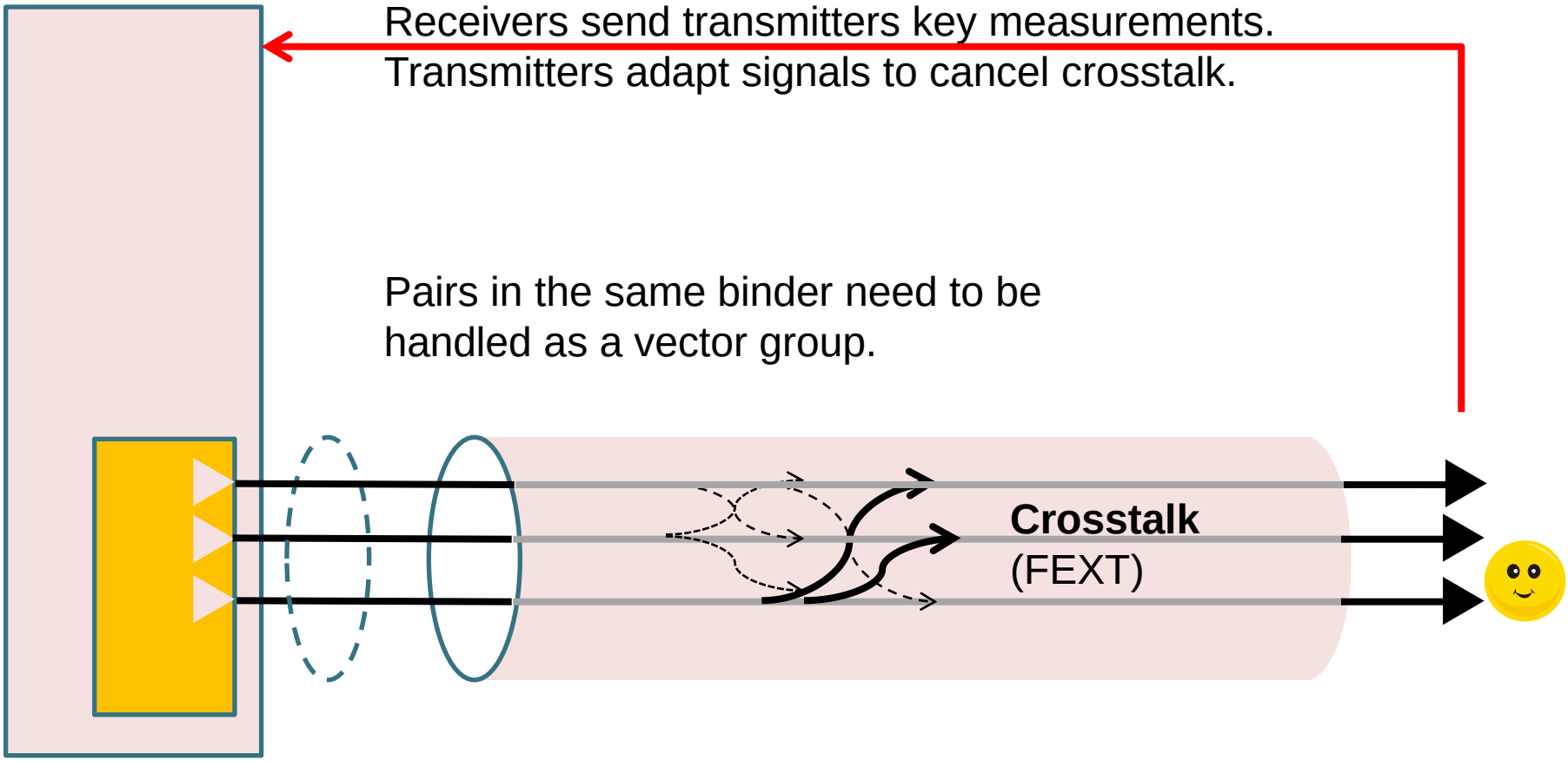
A Single Pair's Interference = Major Impact



Vectoring Addresses Crosstalk

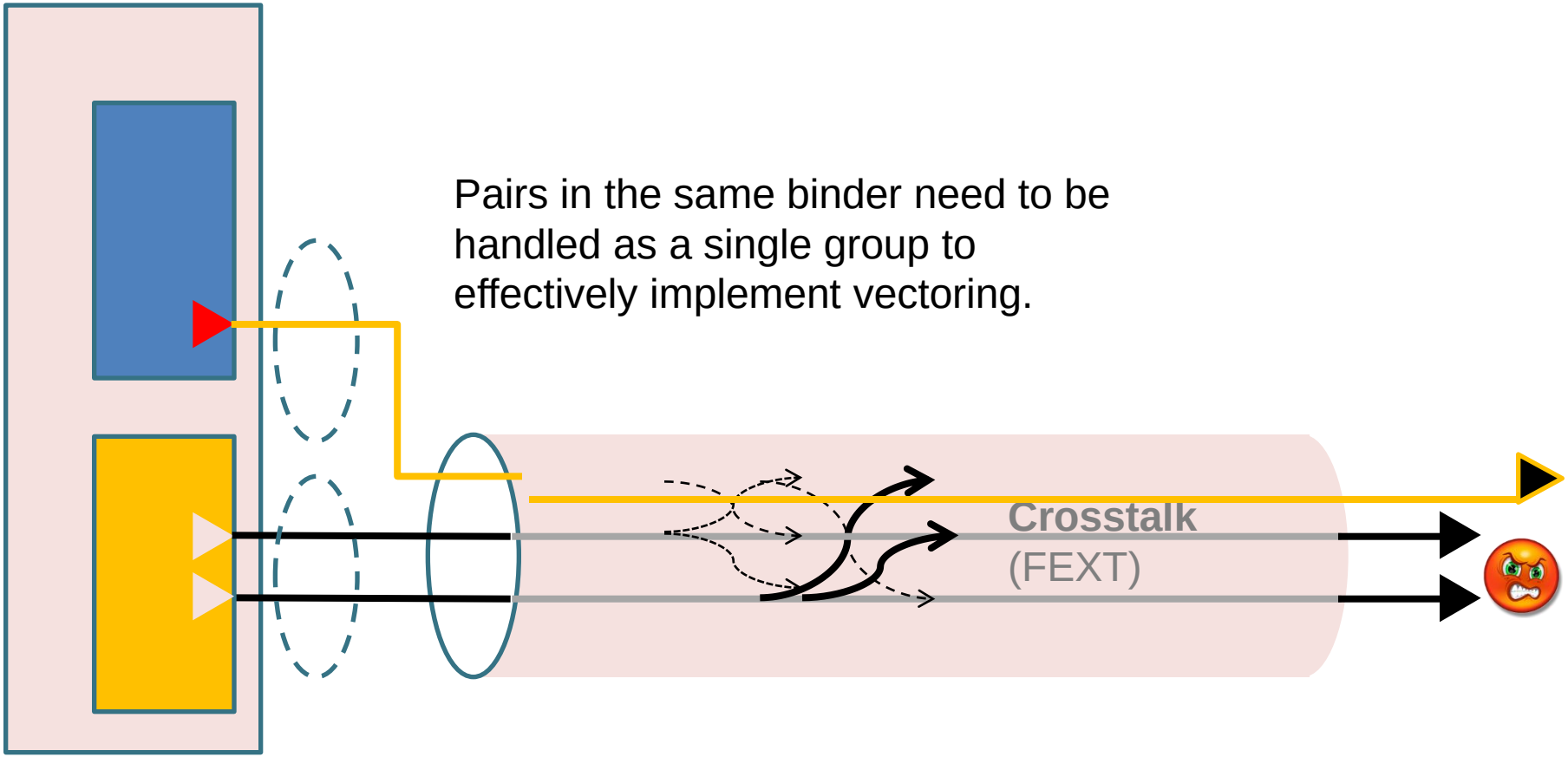
Receivers send transmitters key measurements.
Transmitters adapt signals to cancel crosstalk.

Pairs in the same binder need to be handled as a vector group.



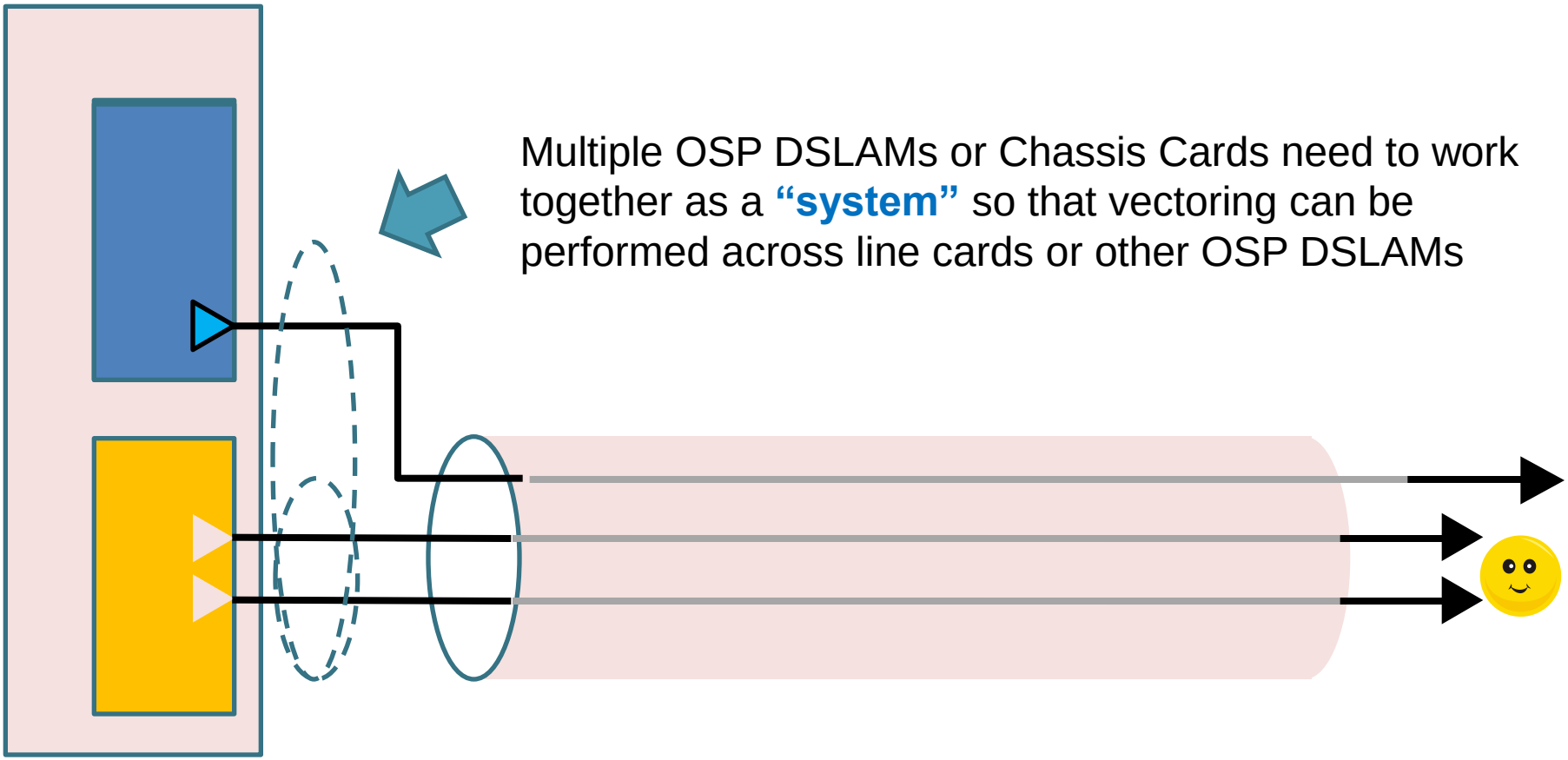
The Problem with Vectoring

Not Everyone Can Join the Team



The Solution - A System Approach

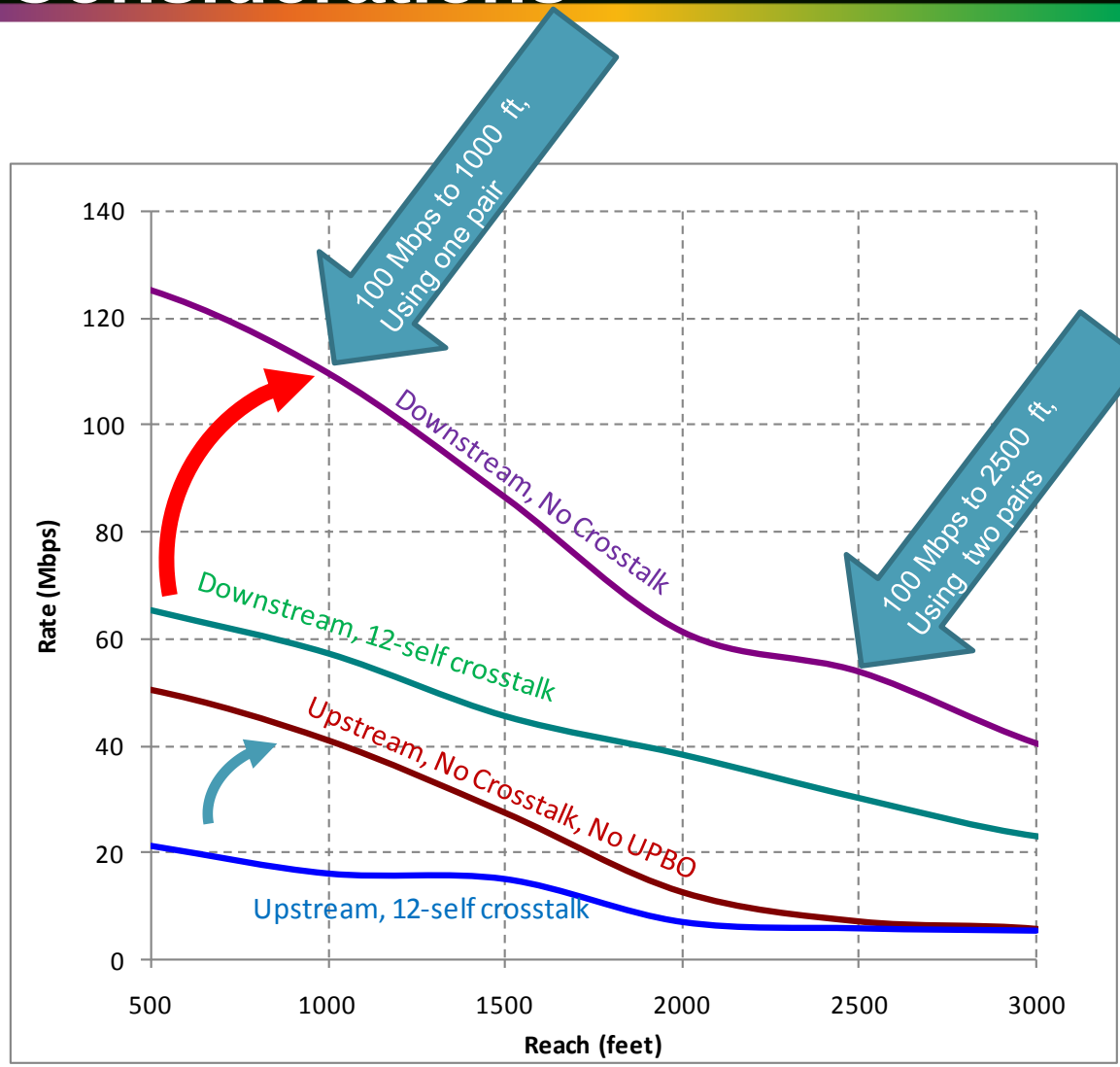
Letting Everyone Join the Team



Multiple OSP DSLAMs or Chassis Cards need to work together as a **“system”** so that vectoring can be performed across line cards or other OSP DSLAMs

Vectoring Benefits and Considerations

- Vectoring has the potential to cancel crosstalk in a binder:
  - All users see rates as if they were the only user in the cable
- Benefits
  - Substantial improvement in speed
  - Can reach 100Mpbs at 1000ft single-pair, or 2500ft with two-pair bonding
- Considerations
  - Limited to short loops (less than 3,000 ft.)
  - Need system-level approach

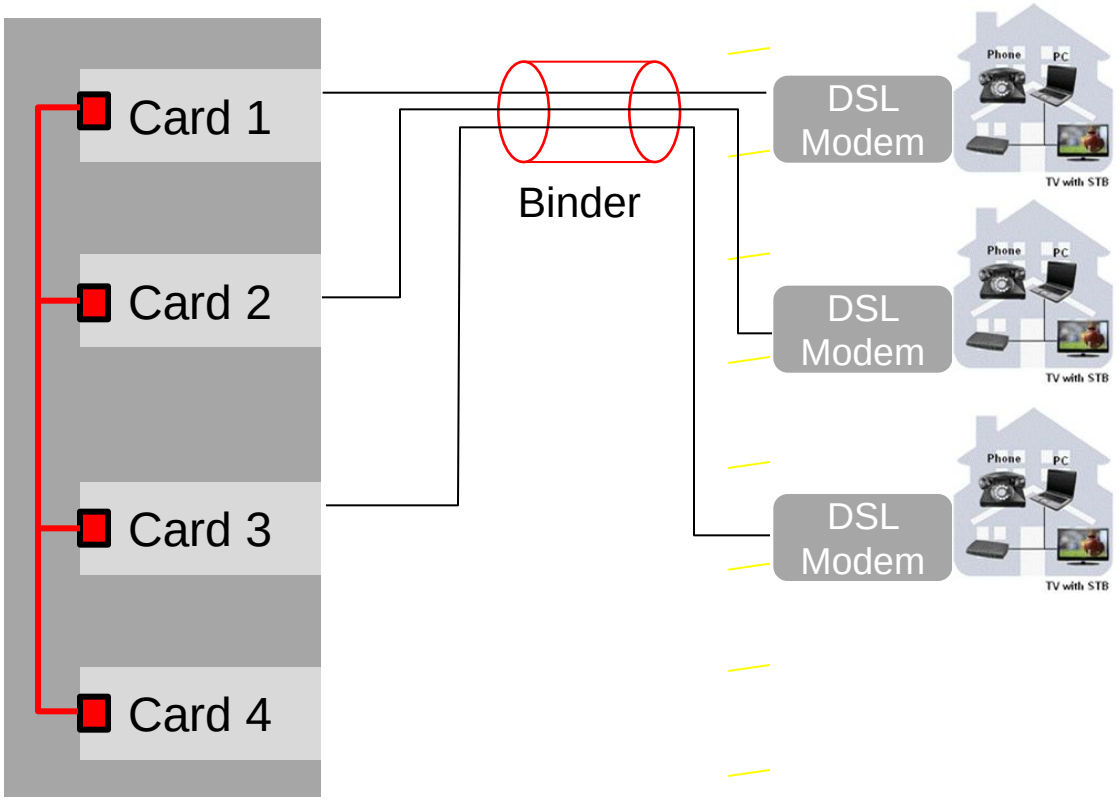


26 AWG equivalent: Multiply vectored reach by 1.3 for 24 AWG

System-Level Approach

Across Cards in a System

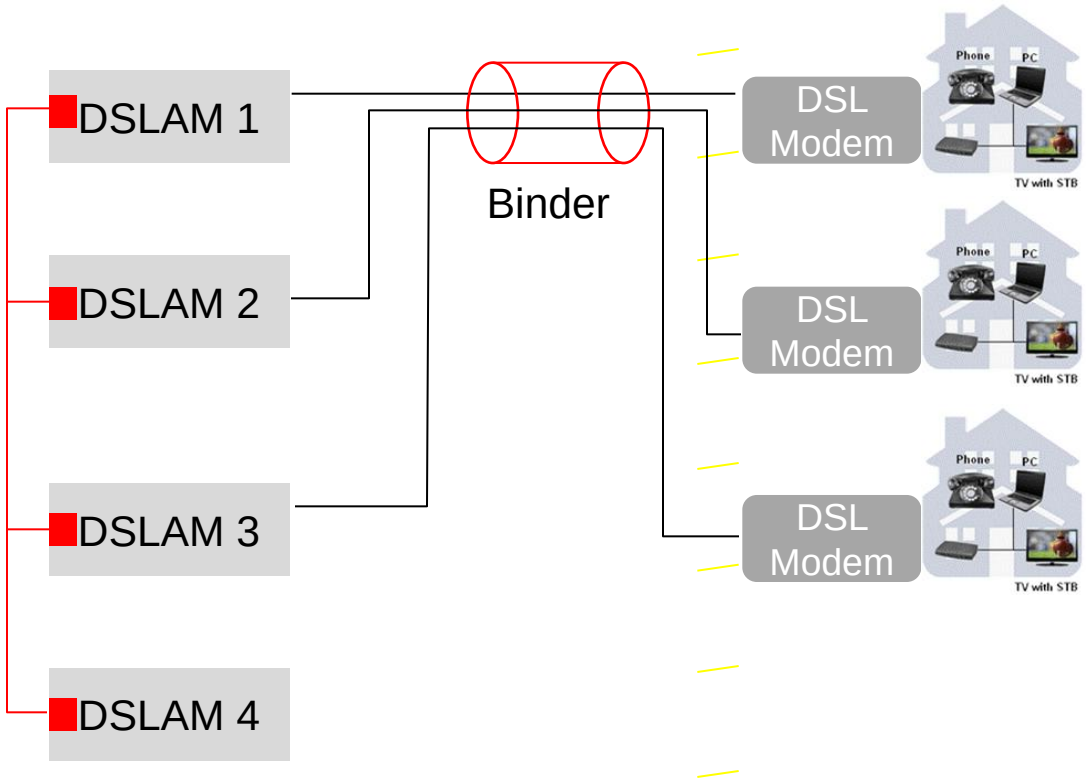
Line cards need to communicate to cancel crosstalk on pairs in the same binder.



System-Level Approach

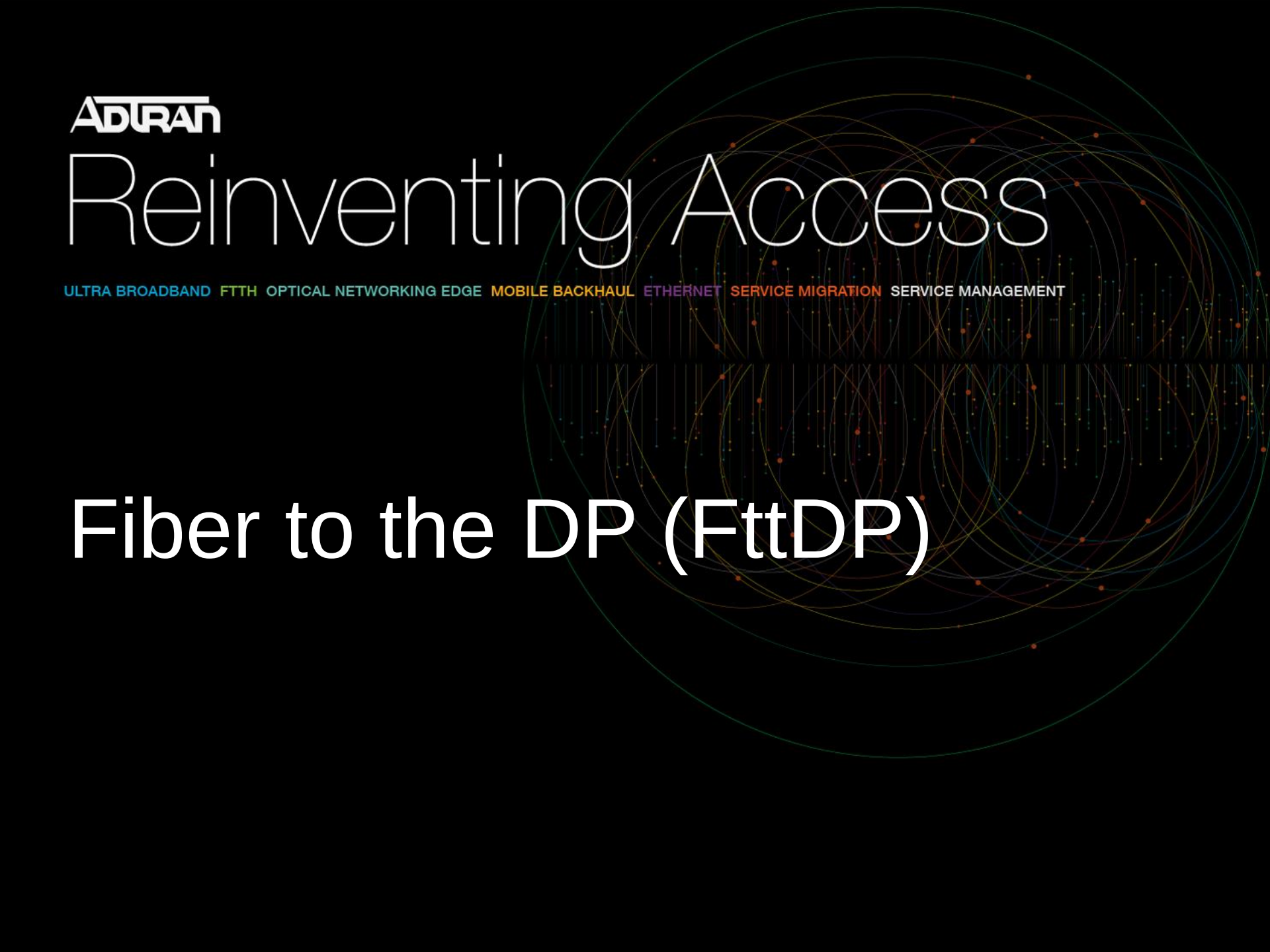
Separate DSLAMs need to communicate to cancel crosstalk on pairs in the same binder.

This is of high value when deploying small systems like 48- port OSP DSLAMs



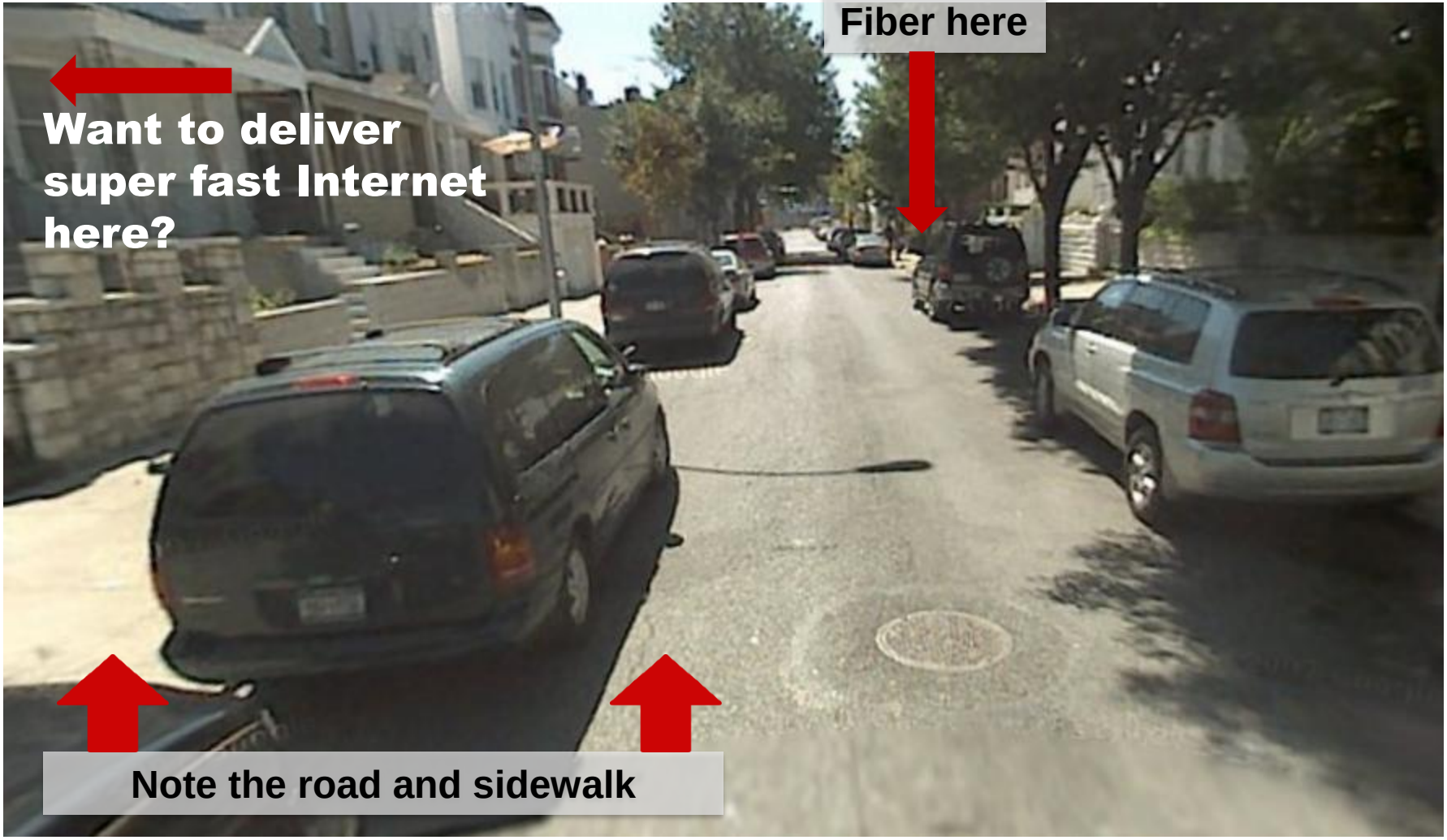
Vectoring

- Helps manage crosstalk in binder groups to increase rate
- Most “bang for the buck” on short loops
- A system-level approach is key

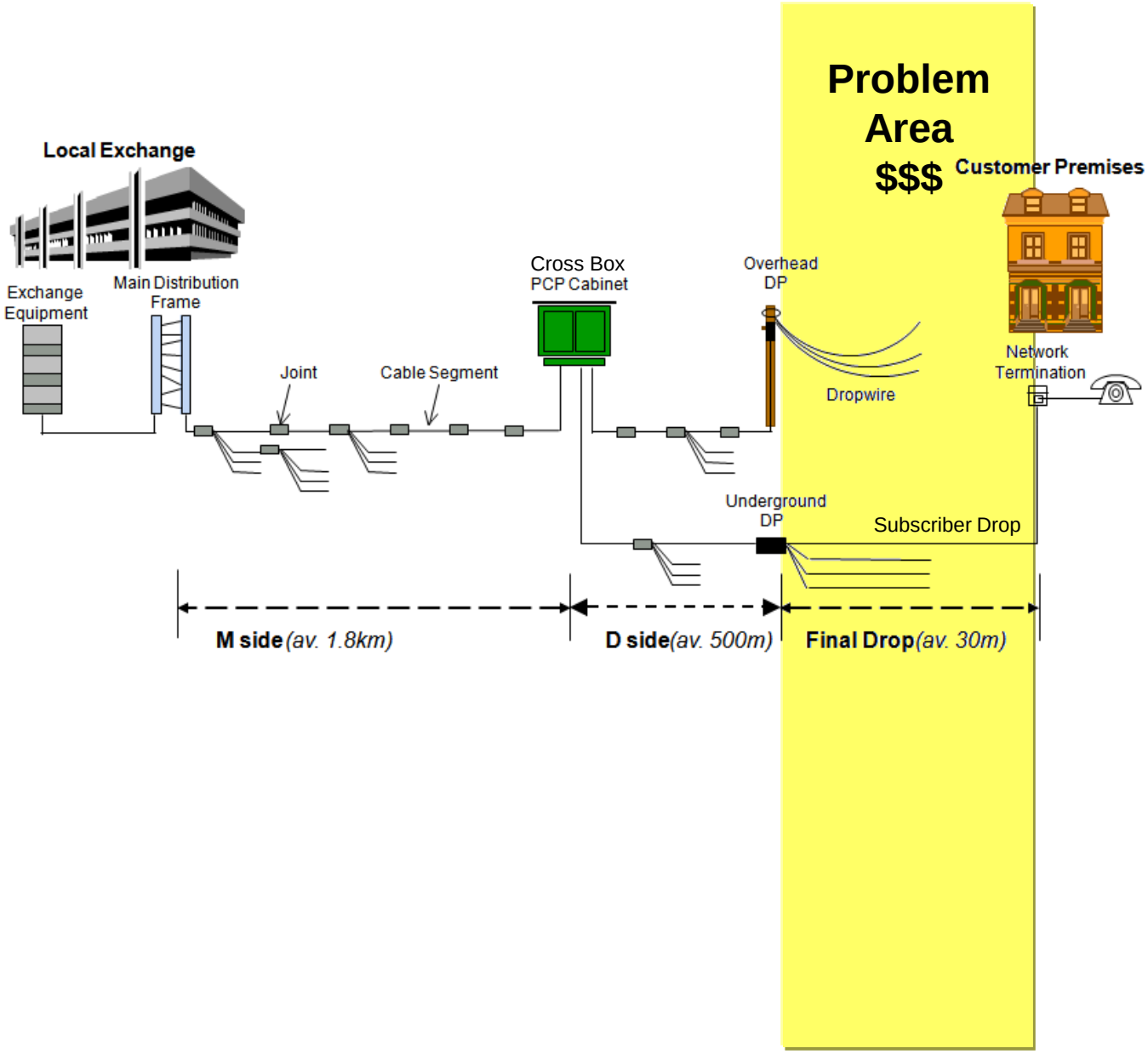


Fiber to the DP (FttDP)

A Common FTTH Scenario



FttDP - Deploying Deep in the Network



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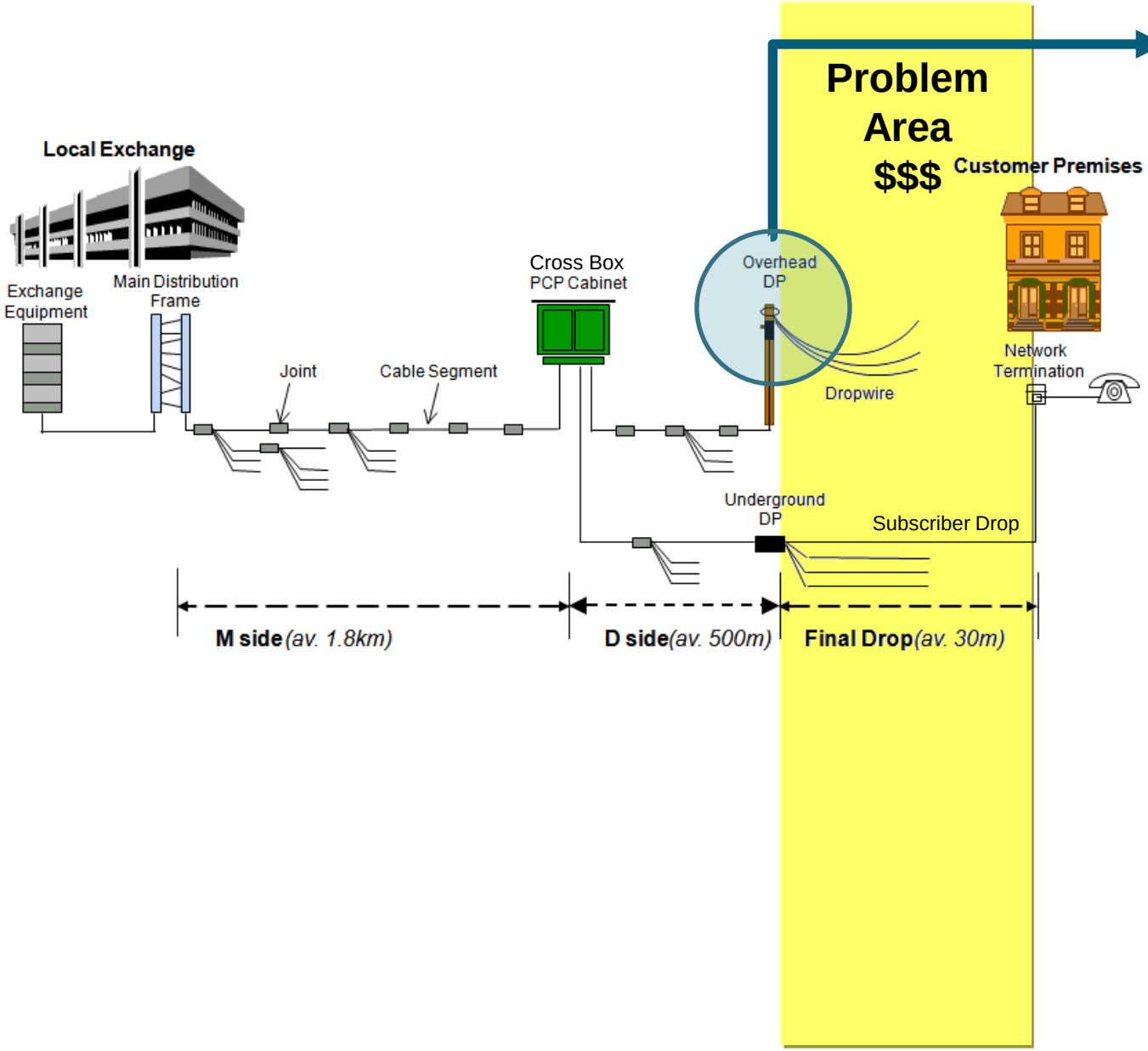

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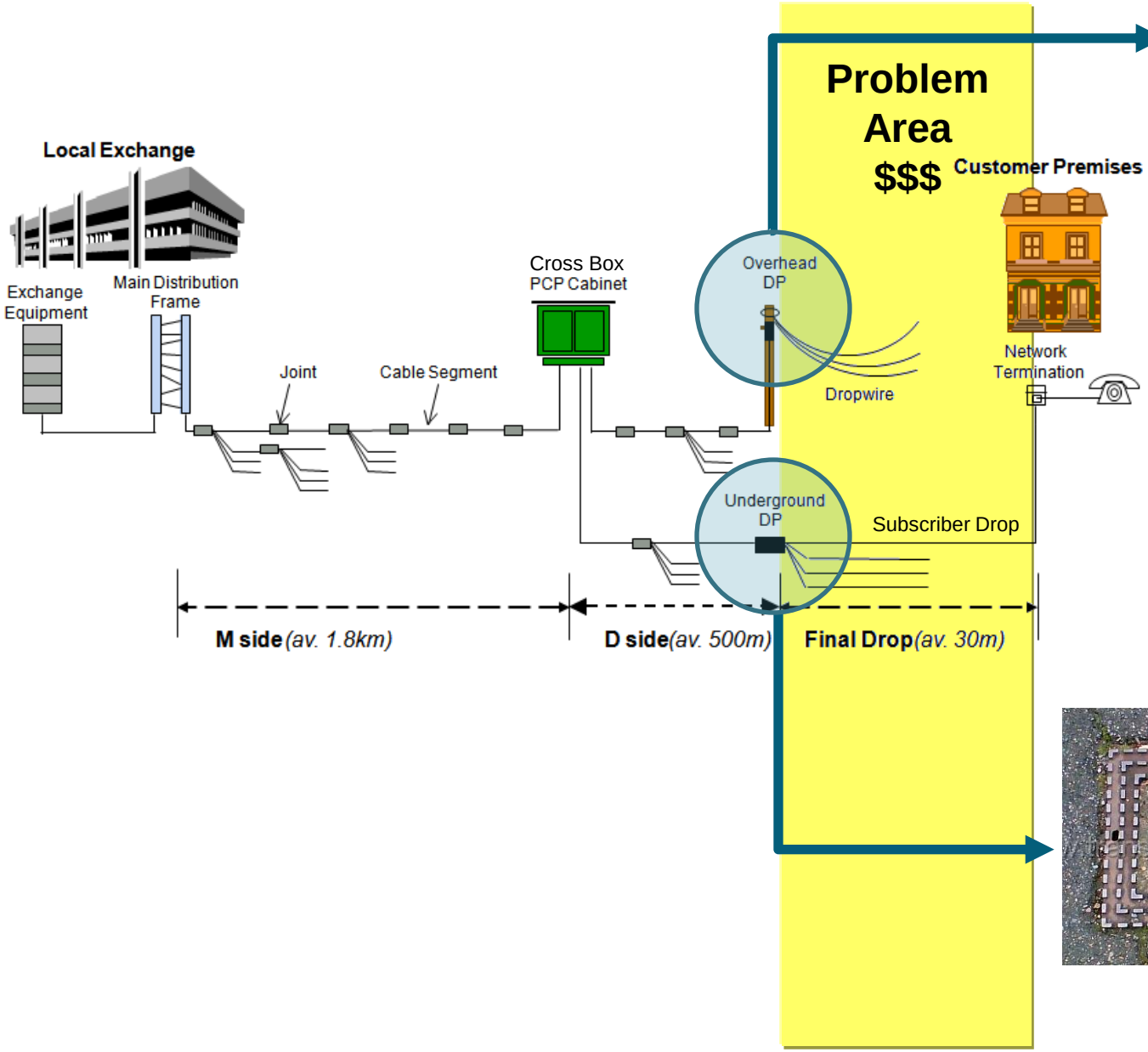

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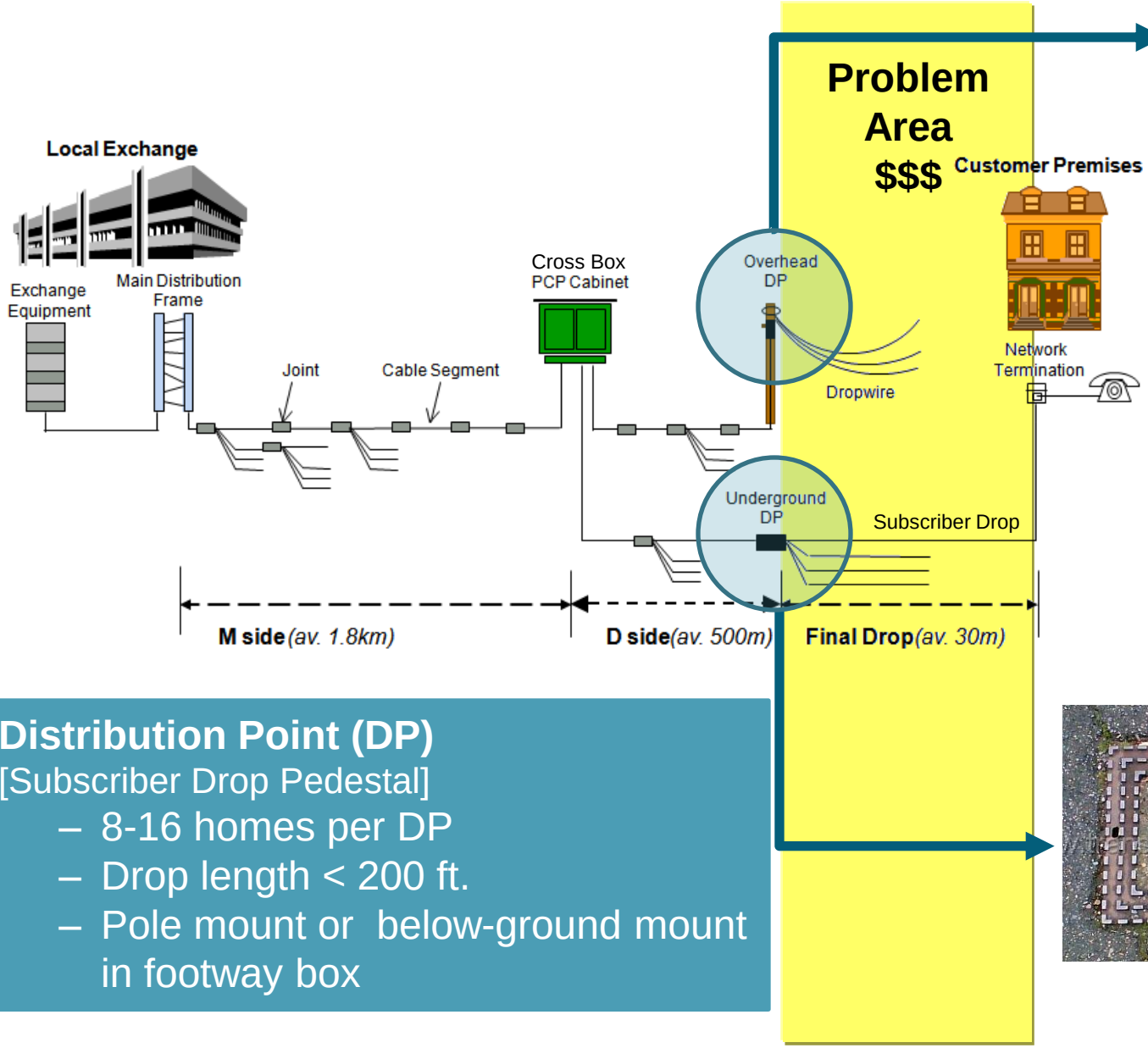
FttDP - Deploying Deep in the Network



Distribution Point (DP)
[Subscriber Drop Pedestal]

- 8-16 homes per DP
- Drop length < 200 ft.
- Pole mount or below-ground mount in footway box

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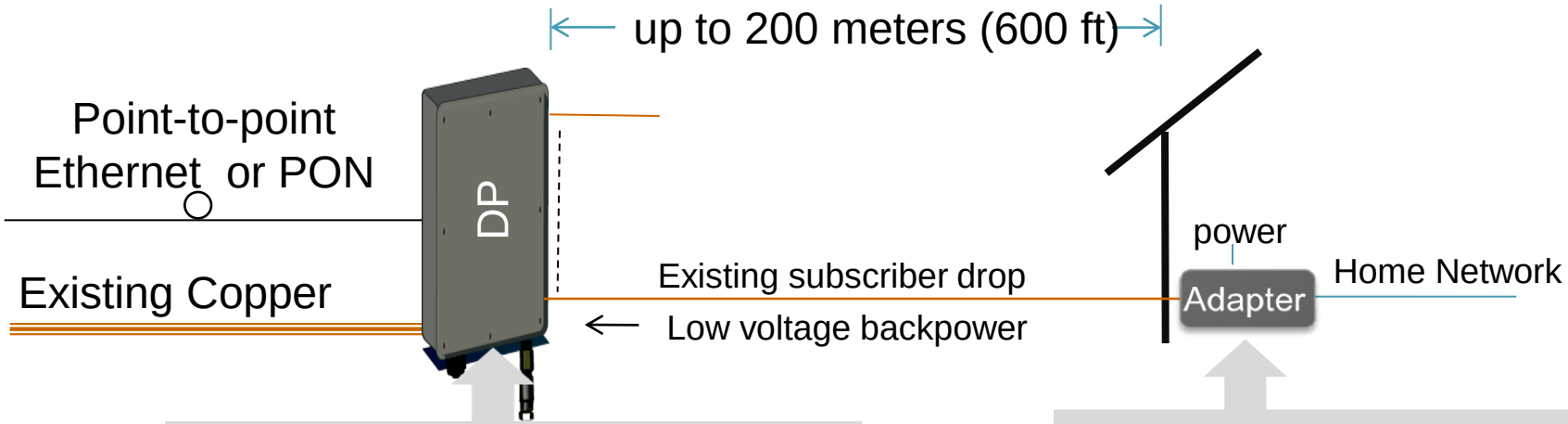
FttDP – A Closer Look



DP Electronics
- **Sealed and submersible**
  - Install anywhere, zero maintenance
- **Low power**
- **Small packaging**
- **Low cost**
- **Reverse powered**

Adapter
- **Easy install**
- **Converts DP signal to home network**
- **Provides back power to DP**

ADTRAN is in over 20 trials around the world with products based on this architecture.

Future FttDP Standard: G.fast

- Fundamental copper technology: Vectored TDD DMT
  - Reach: up to 200m
  - Rate: up to 1Gbps
  - Latency: less than 1msec
  - Spectrum: operates above the VDSL2 spectrum up to 100MHz
  - Vectored to eliminate crosstalk in shared cables
  - Typically 8-16 ports per DP
- Timeline
  - Standard likely completion: June 2013
  - Chipset availability 2H2014
  - System availability 2015

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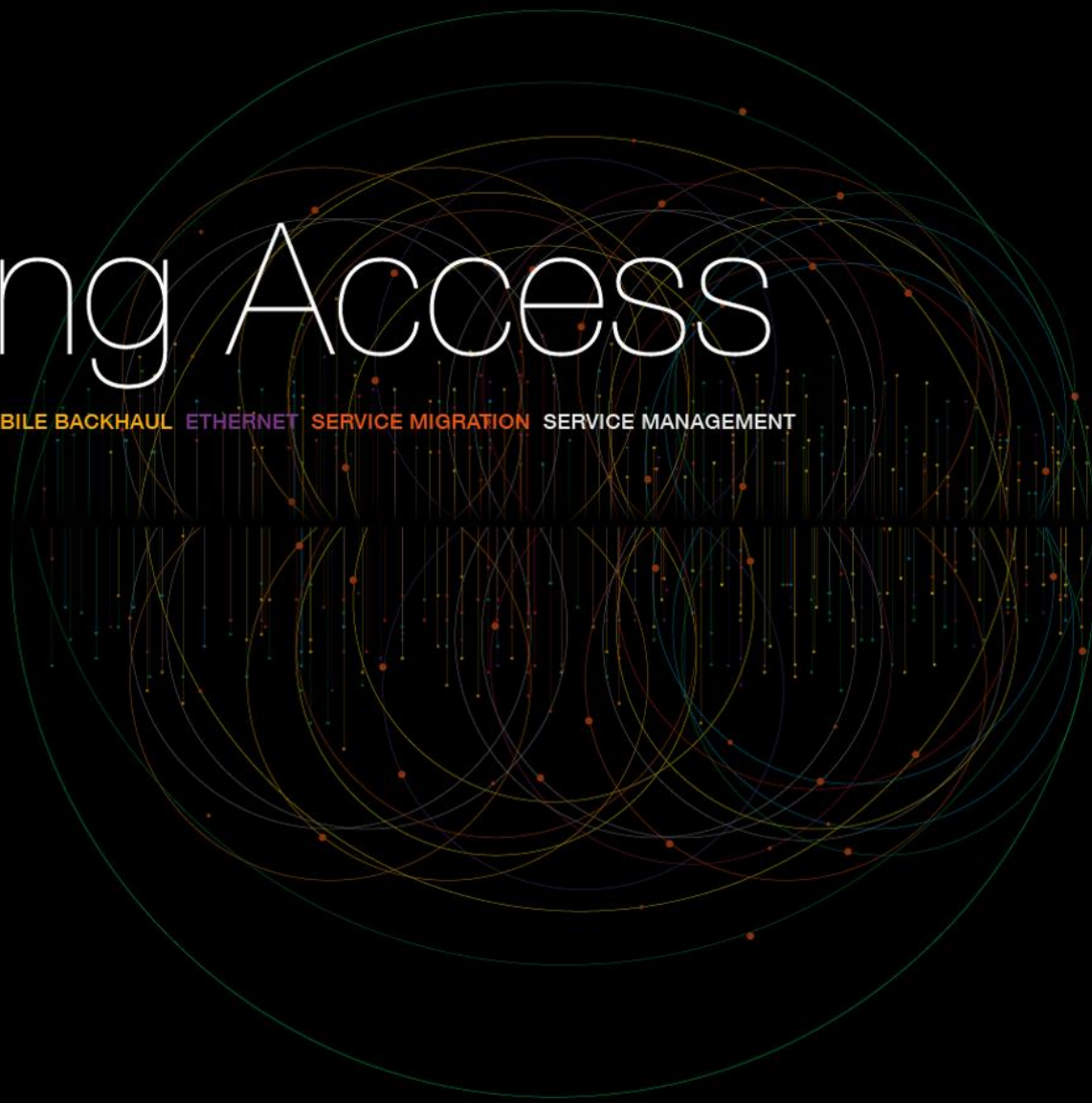
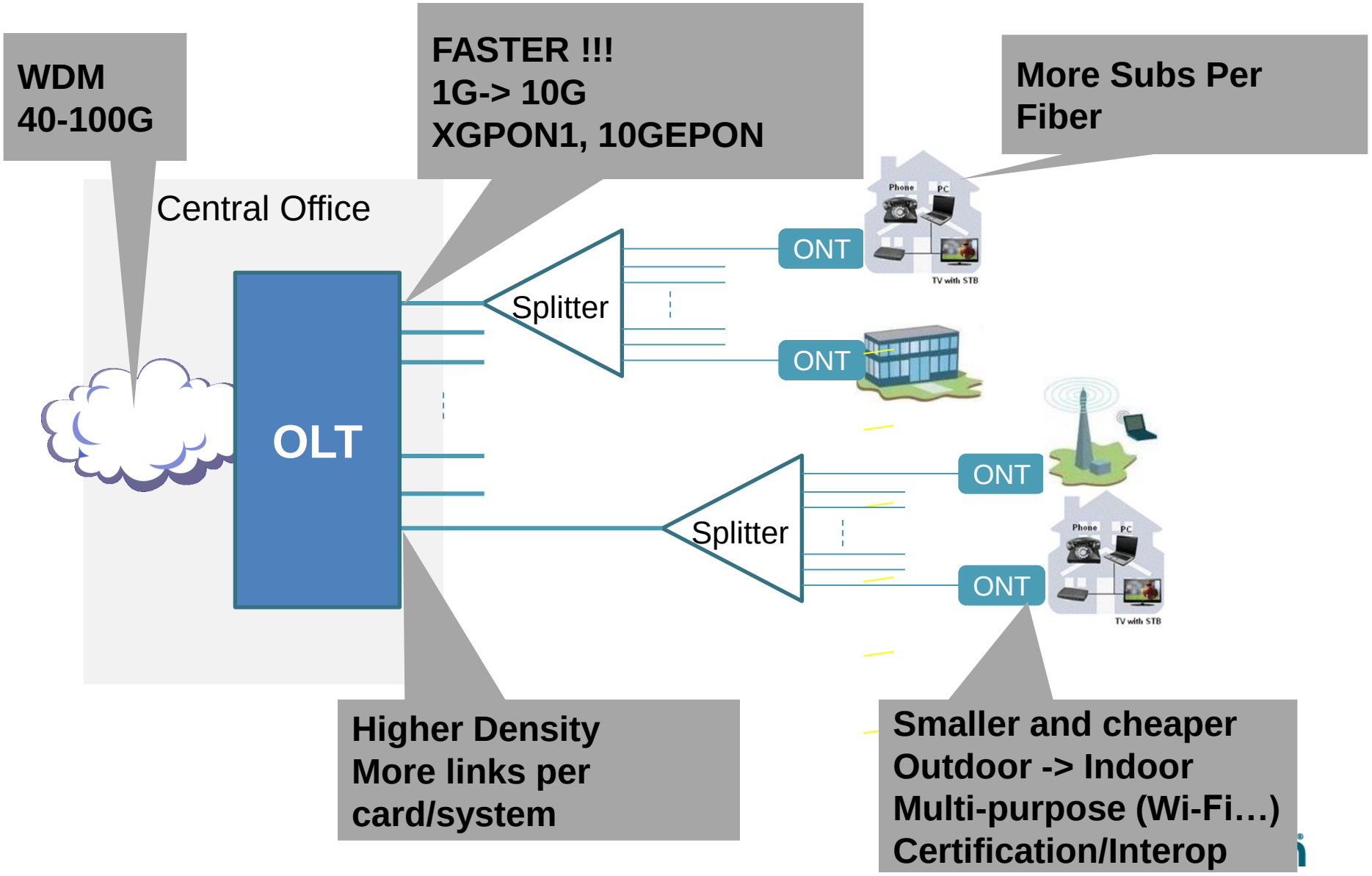


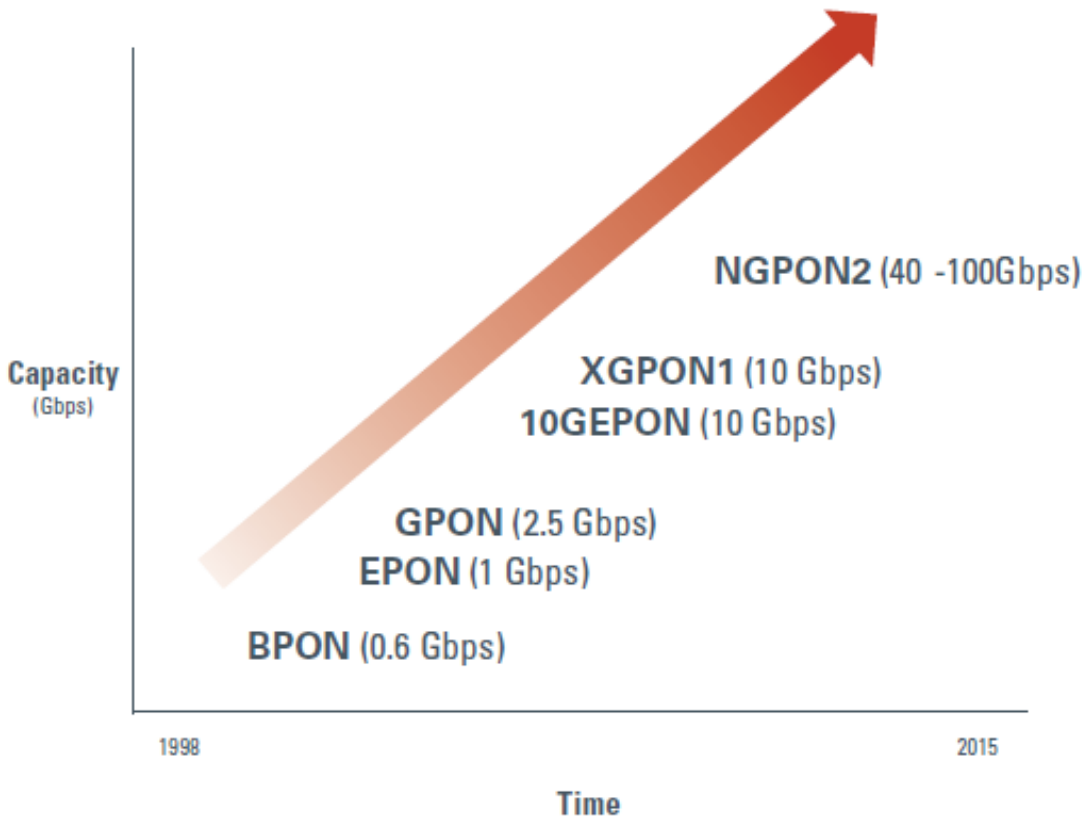
FTTH

PON: Evolution



Next-Gen PON Standards Roadmap

PON Evolution



- Drivers exist for higher bandwidth per home
- Component technology is advancing
- 10G PON technology is available
- NGPON2: Delivering 40-100Gbps using multiple wavelengths

More on FTTH Advancements

FTTH FIBER TO THE HOME COUNCIL

The FTTH Council will host a Fiber Community Web Seminar on **Wednesday September 14, 2011 at 2:00pm EST (1:00pm CST).**

Mr. Richard Goodson has nearly 30 years advanced communication technology experience, from spread spectrum radios to xDSL and PON. He has a BSEE from The University of Alabama and a MSEE from the University of Florida. He participates in the Broadband Forum, ITU-T, FSAN, and ATIS. He has been at ADTRAN since 1995 where he is currently director of industry standards and technology analysis in the CTO Office.

http://www.ftthcouncil.org/en/events/webinars/2011/09/06/webinar-whats-next-in-ftth

ADTRAN think.share.lead

http://blog.adtran.com/tag/ftth/

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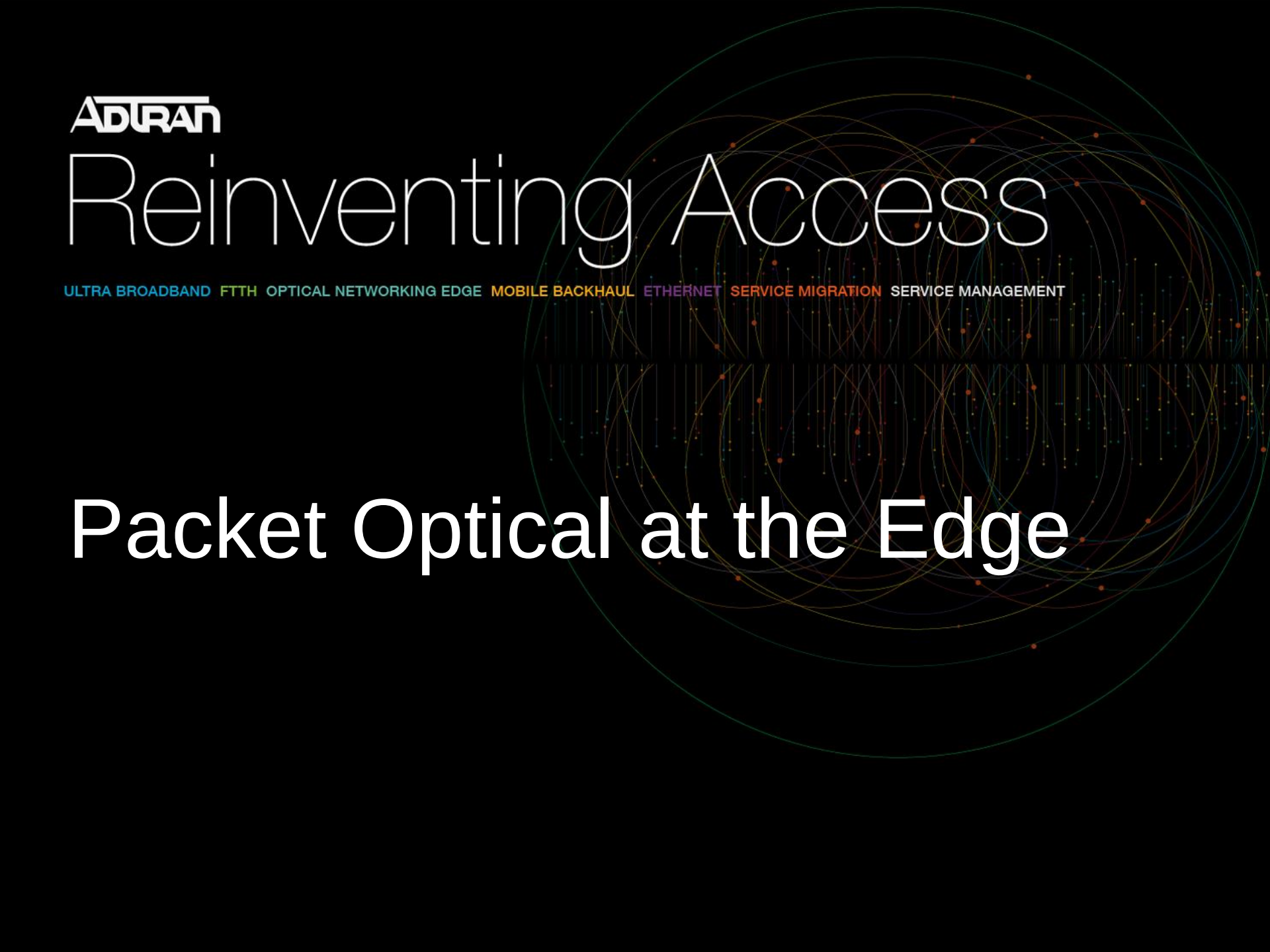
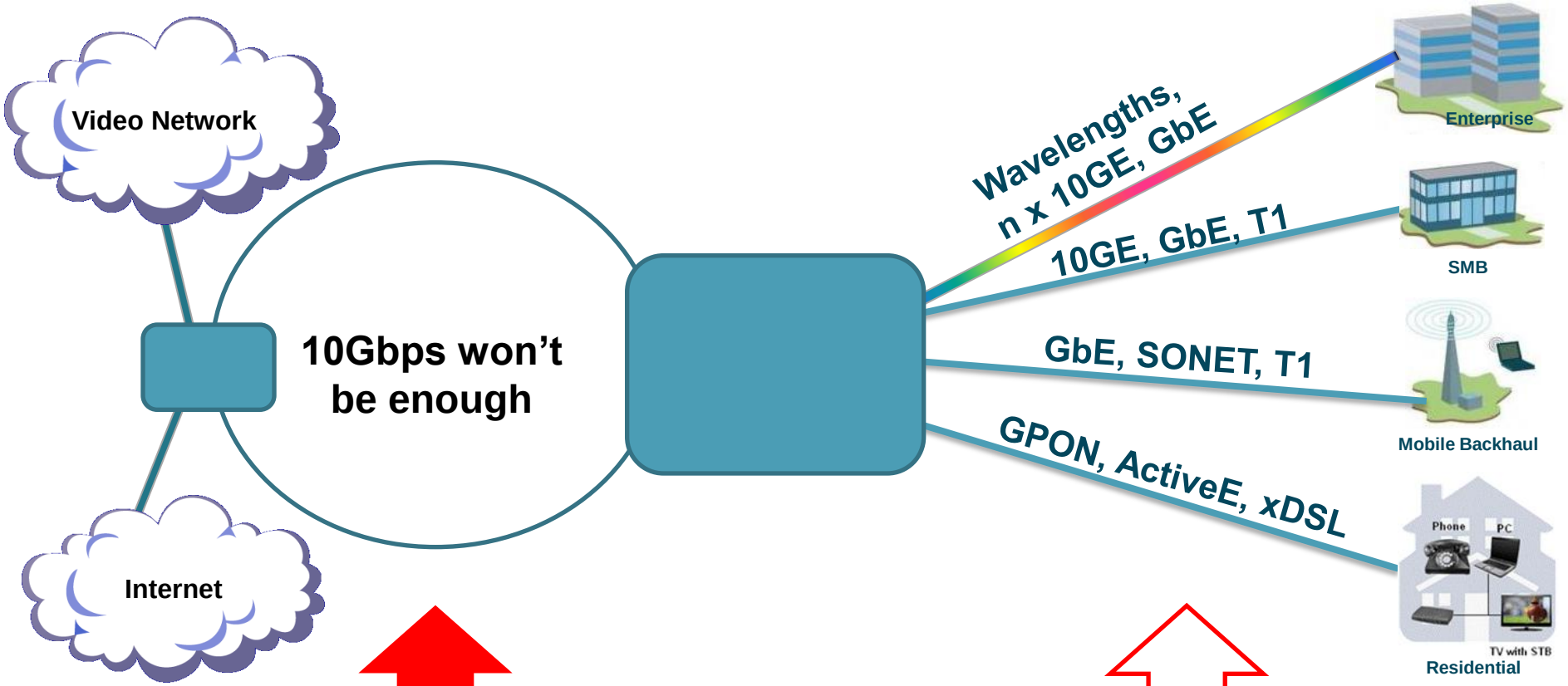


Packet Optical at the Edge

The Next Bottleneck – The Network Edge



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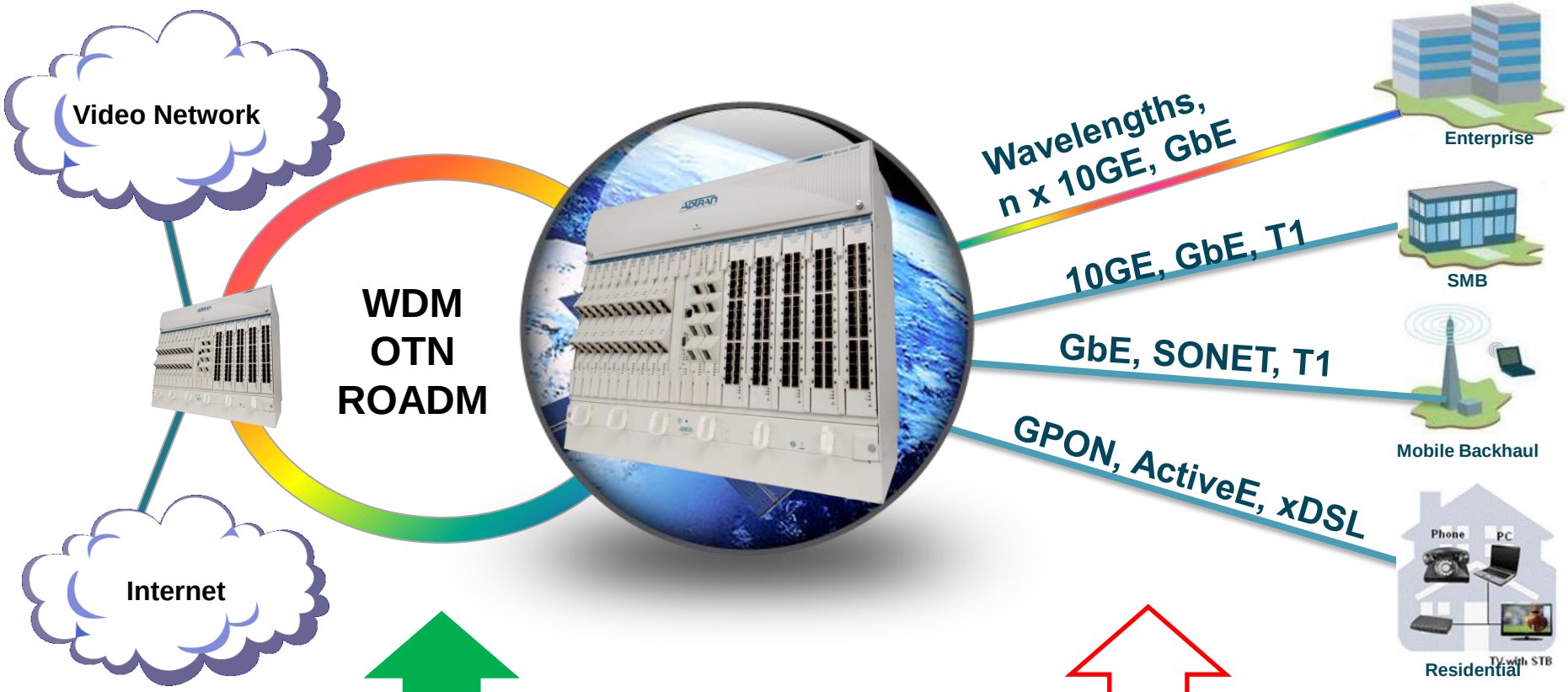
Solve the Bottleneck Before It Happens



Virtually Unlimited Transport

Exploding Bandwidth

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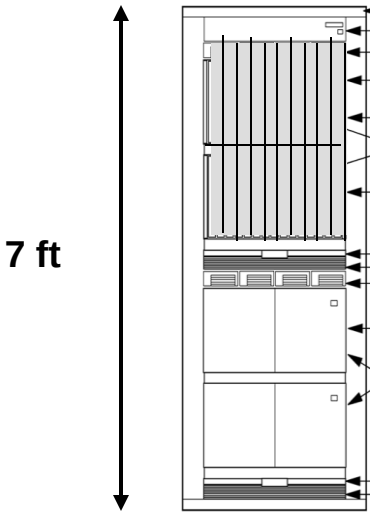
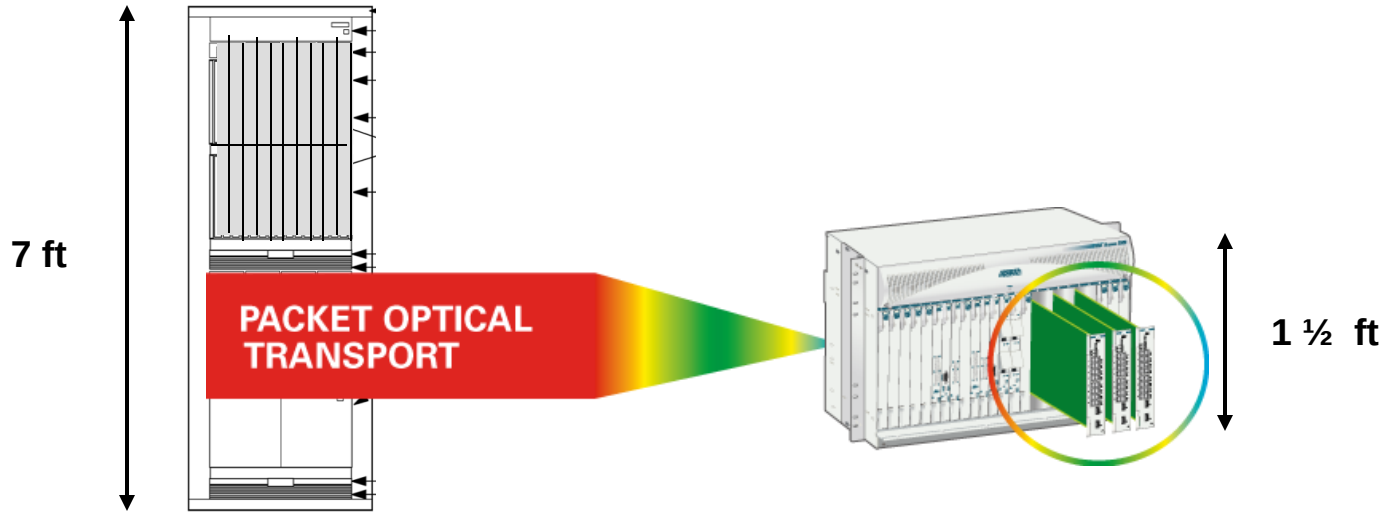
Edge Packet Optical Solution



- Core-transport focused
- Optimized for high port and wavelength counts
- Very-high throughput
- Dedicated NMS and OSS integration
- High start-up cost and complexity

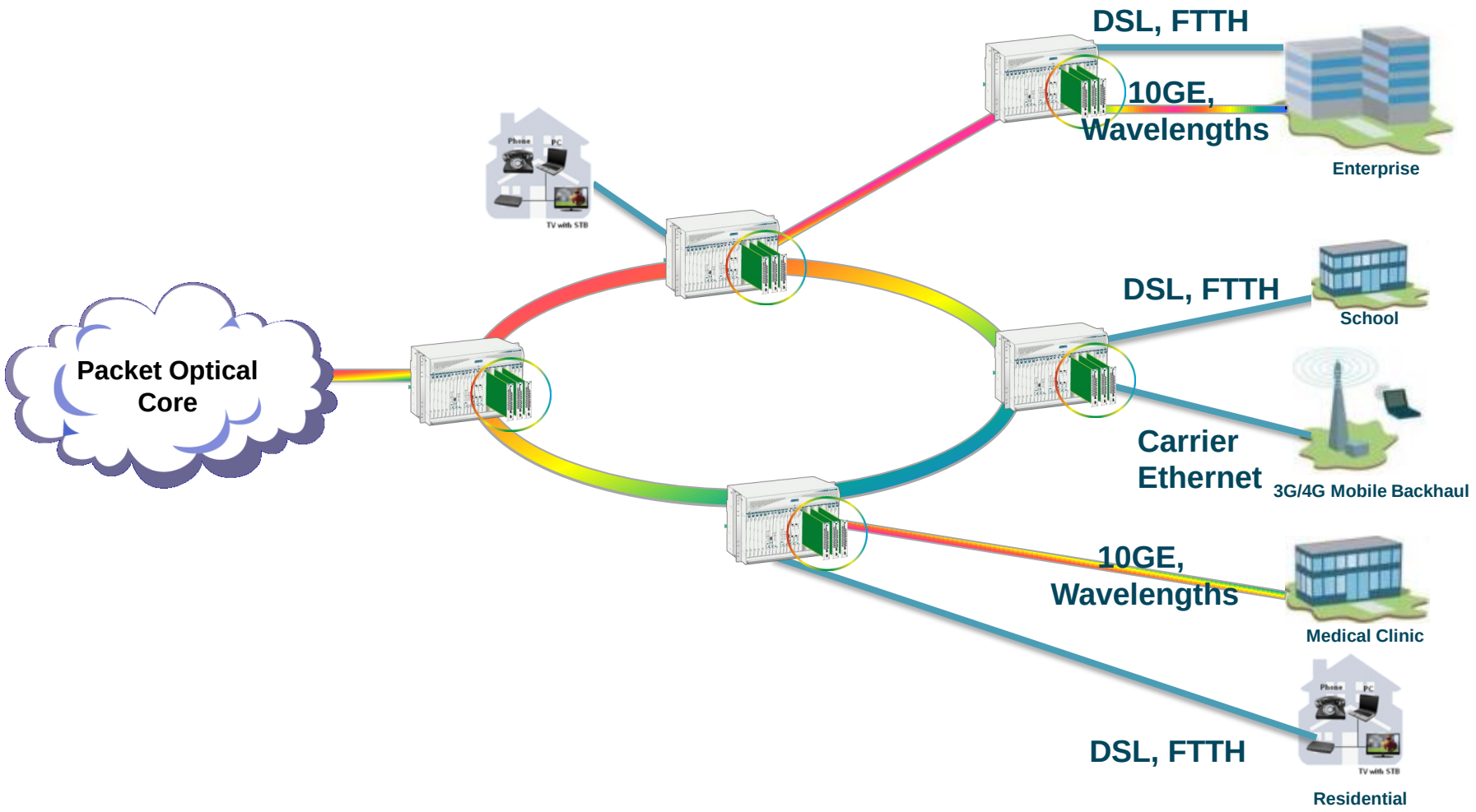
Edge Packet Optical Solution



- Core-transport focused
- Optimized for high port and wavelength counts
- Very-high throughput
- Dedicated NMS and OSS integration
- High start-up cost and complexity

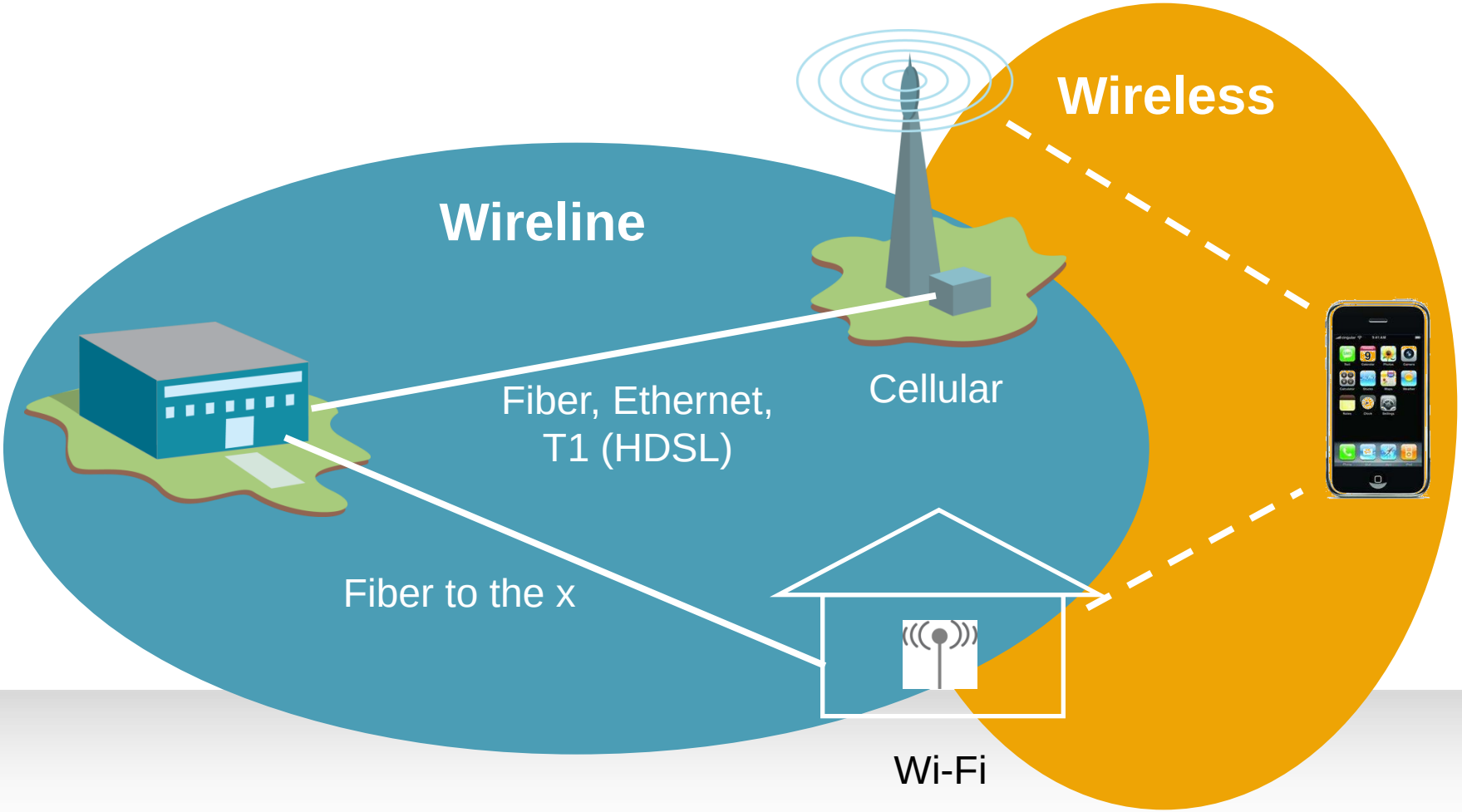
- Edge-optimized performance
- Cost effective at low port counts
- Converged access and transport
- Shared NMS/OSS with existing access system
- Low start-up cost and simple to operate

Solving the Edge Bandwidth Problem



What's Next in Wireless Access?

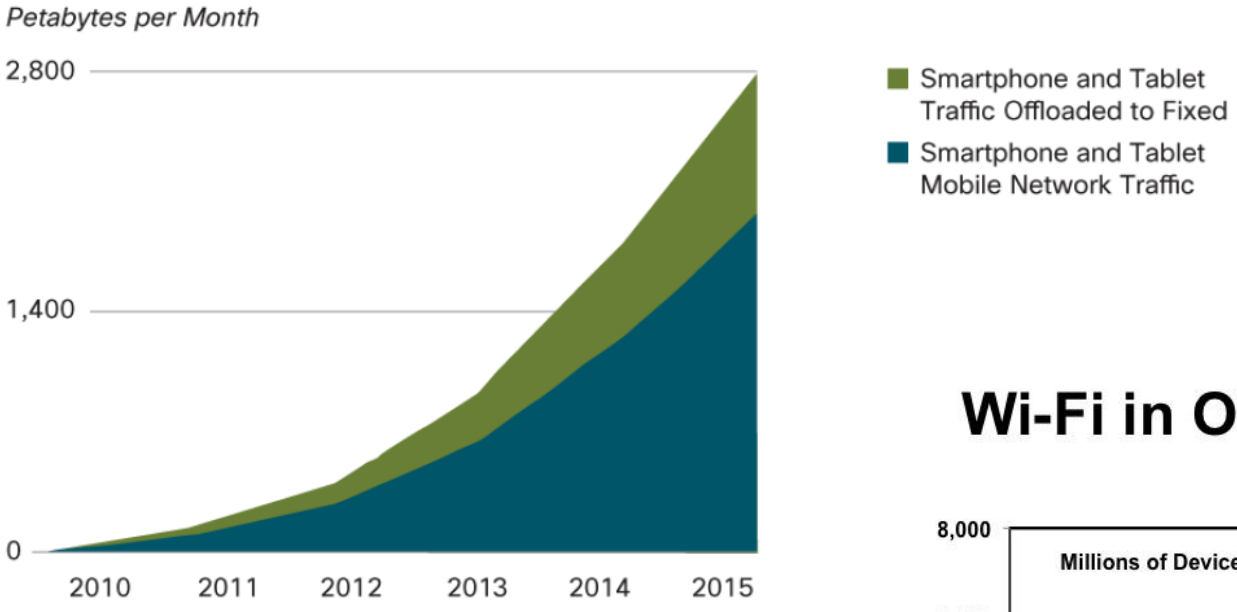
Wireless Is A Wireline Network



"Out of the air and into the ground at closest point"

Wi-Fi Offload for Mobile Data

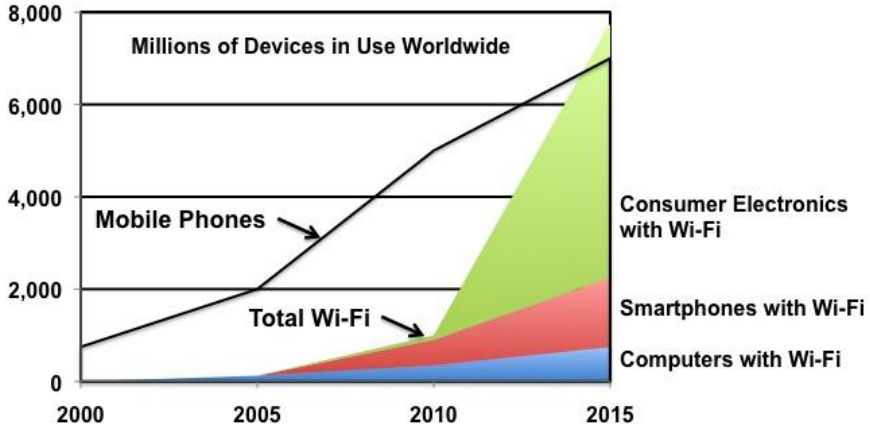
Figure 6. 39 Percent of Smartphone and Tablet Traffic will be Offloaded by 2015



Source: Cisco VNI Mobile, 2011

Growth in tablets and smartphones driving demand for Carrier Wi-Fi

Wi-Fi in Overdrive



NORTH RIVER VENTURES Source: NRV estimates

Hotspot 2.0

- Industry initiative to develop standards-based interoperable Wi-Fi discovery, authentication, encryption and handoff
- Enables handoff between cellular and Wi-Fi networks
  - Mobile handset users can roam between the two networks without the need for additional authentication
- Network discovery and selection
  - Identify and associate networks without active subscriber intervention
- Seamless network access
  - Automatic authentication using credentials stored on device
- Secure authentication and connectivity
  - All connections encrypted

"*Users go to a hotspot and it just works – no need to do anything*"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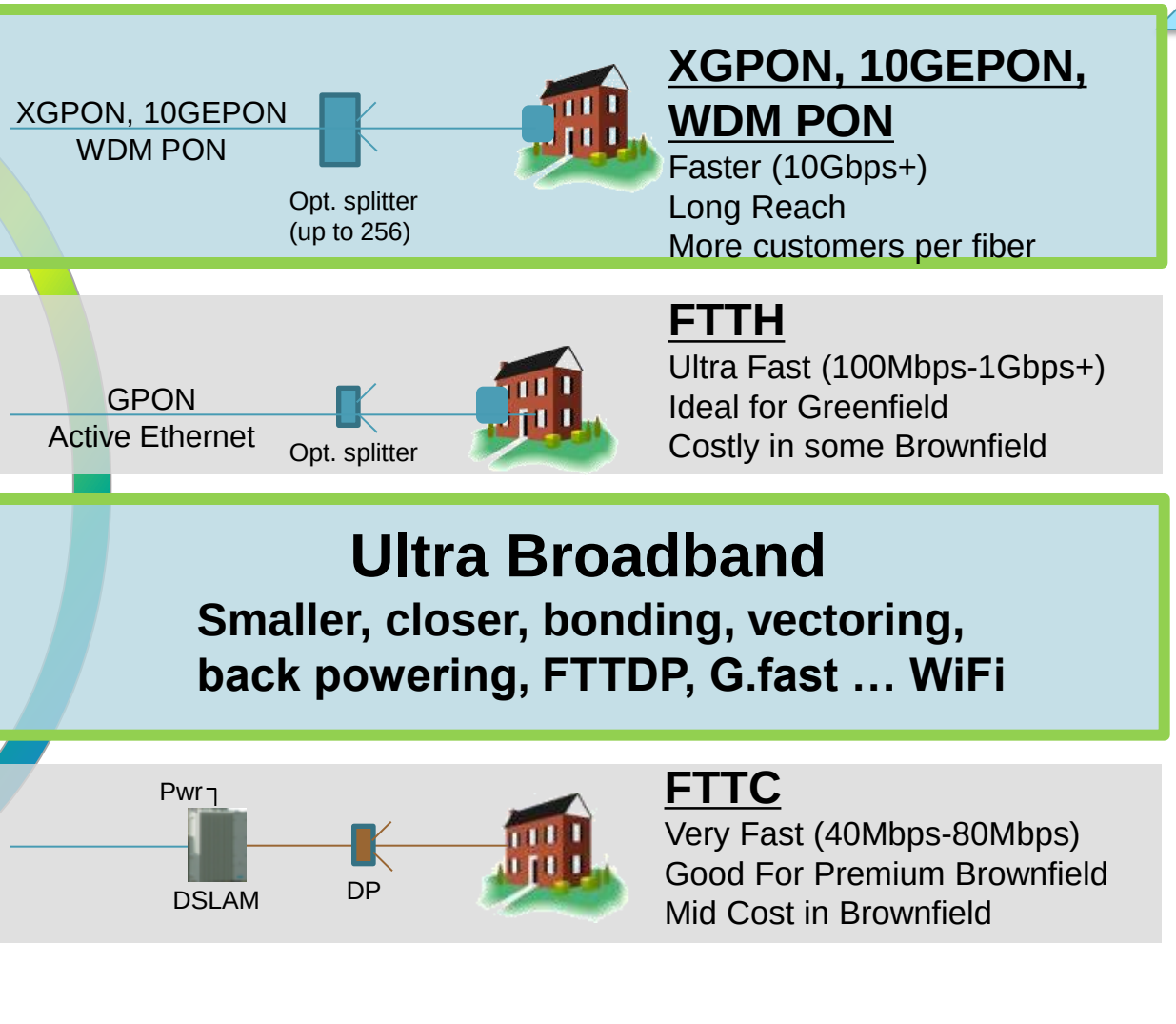
Summary

Summary: Closing the Gap and Beyond

Packet Optical at the Edge

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Questions?

Upcoming USTelecom Webinars

- April 26: ***LTE & Wi-Fi Offload***

  Cisco

- May 3: ***Rapid Service Deployment with IMS Simplification***

  Acme Packet

- May 31: ***Delivering Multi-screen Video and BYOD***

  Cisco